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MINISTRY OF PUBLIC BUILDING AND WORKS

Building Research and Information Services

Report of a Working Party

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Preface

BY THE MINISTER OF PUBLIC BUILDING AND WORKS

The genesis of this enquiry is described in paragraph 4 of the Report. I am grateful to the Working Party for completing its difficult task so quickly. The Report clarifies the outstanding issues and should enable progress to be made in resolving them.

The members of the Working Party from outside the Government service were nominated by interested bodies, but they were not empowered to commit their organisations and the Report represents their own views.

The official members were appointed so that the Working Party might have the benefit of their experience. They played a full part in its work, but it would have been inappropriate for them to join in submitting the Report. The fact that they participated is not to be taken as indicating that the Government have reached conclusions on the Working Party's recommendations.

Further consultations with the interested bodies will be necessary, and the Report is being published in order to facilitate these discussions.

GEOFFREY RIPPON.

March, 1964.

1964

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Introduction

Terms of Reference

1. Our Terms of Reference were:—

> "To examine the need for improved research and information services;
>
> the scope of any Association to achieve improvements;
>
> the constitution of such an Association;
>
> and the arrangements for financing it."

Composition of the Working Party

2. The membership of the Working Party was as follows:—

Chairman: D. E. Woodbine Parish Esq., F.I.O.B.

Members: P. H. P. Bennett Esq., M.A., F.R.I.B.A.
N. S. Farrow Esq., O.B.E., F.I.O.B.
P. W. Grafton Esq., F.R.I.C.S.
E. P. Lawrence Esq.
F. M. Lea Esq., C.B., C.B.E., D.Sc., F.R.I.C., Hon. A.R.I.B.A.
D. C. Mallam Esq., B.A., Barrister at Law.
W. J. Reiners Esq., B.Sc., F.S.S.

Assessors: M. F. Kaplan Esq., D.Sc. (Eng.), Ph.D., B.A., B.Comm., M.I.C.E., M.I.Struct.E.—Director, Civil Engineering Research Council.
J. Knox Esq., M.A.—Department of Scientific and Industrial Research.

Research Officers: K. Alsop Esq., B.Sc., A.Inst.P.—Building Research Station.
O. P. Carver Esq., A.R.I.B.A.—Ministry of Public Building and Works.

Secretaries: E. R. Brunning Esq.—Ministry of Public Building and Works.
D. Gardiner Esq.—Ministry of Public Building and Works.

3. Mr. V. J. Stock attended the first meeting and Mr. F. C. Withey (Ministry of Public Building and Works) was our secretary for the first two meetings. Mr. E. P. Lawrence was co-opted to the Working Party to advise on matters relating to building materials.

Origin and Method of Enquiry

4. On the 22nd May, 1963, and 1st July, 1963, the Minister of Public Building and Works wrote to representative organisations in the building

and associated industries and professions proposing the establishment of a Building Research and Information Association. It would be financed primarily by the industries concerned, with the Government contributing up to £150,000 a year for the first three years of the Association's existence. The proposal was discussed between the Minister and a deputation led by Sir Harry Pilkington on the 11th September, 1963, at which agreement in principle was reached and it was decided to constitute a small Working Party with the terms of reference quoted above. (The Minister's letters are reproduced for convenient reference as Appendices A and B.)

5. The Working Party has held six meetings, has visited the Building Research Station and has taken oral evidence from the Director of the Building Centre, London. Some members have also visited the Cement and Concrete Association's Research Station. In addition, our Research Officers have approached 176 research organisations, professional bodies, building firms, technical journals and individuals as listed in Appendix C; of these, 24 were in Scotland.

6. In view of the limited time available we have not conducted a comprehensive survey in depth into the industry's needs for research and information. The subject is, however, already well documented and we are satisfied that the Working Party's collective experience, supplemented by the Research Officers' oral and written reports (which covered 24 visits and the analysis of 115 completed questionnaires), together with other information which we have examined, have enabled us to sound a reasonable cross-section of the industry and to reach valid conclusions.

7. The Report of the Trend Committee on the Organisation of Civil Science was published after the Working Party had been established. The Government's decisions on this document and in particular on the future organisation of the Building Research Station are still awaited, but we should not expect them to modify our main recommendations; these are summarised at the end of our report.

Preliminary Appreciation

Definitions

8. We have not attempted precise definitions of "research" and "information", but have described their scope in general terms in the relevant sections of the report (those commencing with paragraphs 21 and 42, respectively).

9. We found difficulty in defining "the building industry" satisfactorily for our purposes, and we decided to regard building and civil engineering (together with their associated mechanical and electrical services) as separate, but overlapping, activities, rather than as distinct industries. For this reason, while we may refer to "building" as an activity, whenever we use the term "the industry" we refer to construction as a whole. More specifically, we intend the latter term to cover professions, contractors and sub-contractors (including specialists) engaged in broadly the activities listed

in Standard Industrial Classification Order XVII (Construction), which we reproduce as Appendix D to this report. Maintenance represents about one third of the industry's output, and new works the remaining two thirds. Where we wish to include building material producers and suppliers with the industry, they are mentioned separately.

Productivity and Economic Growth

10. We have no need to argue the vital importance of the construction industry to the economic growth and social well-being of the country, and as a Working Party, we endorse the statement in the Minister's letter dated 22nd May, 1963, that:

> "If building investment, both social and economic, is to grow quickly enough to meet the nation's needs the industry will have to increase its output and its productivity at an unprecedented rate. Growth at this rate calls for a heavy research effort and for intensive measures to secure the dissemination of the best technical information throughout the industry".

11. According to the National Economic Development Council's Report "Growth of the United Kingdom Economy to 1966", the Construction Industry was expecting to increase its gross output between 1961–66 by a total of 21 per cent, for an estimated manpower increase of 5½ per cent. The Minister has recently stated that the industry's output must rise by over 50 per cent in the next decade with virtually no increase in the labour force. To achieve this gain in productivity, the industry must take all possible steps now to raise both managerial performance and operating efficiency.

General Need for Further Research and Information

12. We have compared the scale of research and development effort in the construction industry with that found in other industries, and thus drawn general conclusions about its present adequacy. Excluding the production of materials and components, the annual expenditure on research, development and advisory services for the construction industry is estimated at about £3 millions, representing 0·2 per cent of the net output of the industry of about £1,500 millions per annum.

13. It is difficult to find a comparable figure for research and development on materials and components, the annual output value of which is a further £1,500 millions. From the Federation of British Industries report "Industrial Research in Manufacturing Industry 1959–60" and the Department of Scientific and Industrial Research report "Industrial Research and Development Expenditure 1958" it appears that the expenditure in the glass, cement and ceramics (excluding refractories) industries was about £2 millions. This has to be increased to cover the proportion of the expenditure on metals, plastics, paint and other materials, which contributes to construction. In the absence of any sufficient analysis of expenditure in these industries we can only guess that the relevant figure is of the order of £5 millions. On this assumption, the total expenditure on research and development for the construction industry and its suppliers would be around £10 millions annually, representing 0·3 per cent of the associated annual output of approximately £3,000 millions.

14. By contrast, the national average expenditure on research (including defence research) increased from 2·0 per cent of net output in 1955 to 2·7 per cent in 1961–62. There is, of course, a good deal of variation between industries, and in particular between the technologically based industries such as electronics, chemicals, etc. and the traditional craft based industries such as agriculture and building. Research and advisory services in agriculture, however, account for about 1·3 per cent of net output. While, therefore, we accept that any industry's research needs must be established empirically, these figures suggest that the level of expenditure on building research, however financed, is at present disproportionately low and that the deficiency may well be measured in millions of pounds per annum.

15. We also note from the Treasury's "Bulletin for Industry" dated February, 1963, an extract from which is reproduced as Appendix E to this report, that if the private sector is viewed in isolation the construction industry spends considerably less on research than any of the manufacturing industries listed, though some research in the manufacturing industries is, of course, relevant to construction.

16. The construction industry has often been criticised for its lack of interest in research and its slowness in applying the results. There is no doubt that the leaders of the industry are convinced of the urgent necessity for change, but builders in general have been slow to make use of men trained to the full professional or academic level that would enable them to extract the maximum benefit from research, and thus to achieve the transformation from a craft based to a technologically based industry.

17. It is not only higher productivity in actual construction that is needed to enable the industry to meet the demands falling on it. Equally important, in a rapidly changing society, is the application of research to design, fitting it more closely to the client's requirements and permitting them to be met more economically. The education of architects and other professions in the past has left many insufficiently trained to make full use of advances in science and technology, while in many fields Regulations have had a seriously inhibiting effect on progress.

18. Sir Harold Emmerson in his "Survey of Problems before the Construction Industries" suggests that:

> "The industry and the professions might take a closer interest in research if more could be done in such matters as site organisation, work study, cost control, conditions of employment, and human relations. This will mean more money and staff but there can be no doubt as to the value to be gained."

19. We agree that every step possible must be taken to strengthen the links between research workers and the industry. Research and information activities are indeed only a means to an end, which we see as the continuous improvement of the construction industry's efficiency, and consequently its contribution and service to the community, in terms of rapid growth, better economic use of national resources, greater productivity and higher quality standards. By achieving such results the augmented expenditure on research and information envisaged in our recommendations will ultimately be repaid many times, and the effective annual gross product of the industry progressively increased.

Research

20. With these general considerations in mind, we now turn to the specific developments which the Working Party would wish to see in the fields of research and information.

Scope of Building Research

21. Building research is concerned with obtaining new knowledge about buildings and their environment, both internal and external, and about the whole process of building. Within its scope we have to include research on materials, on structures and foundations, on the physics of environment and on the associated engineering services, on the needs of users, on design and planning, on site operations and their management and organisation, on human factors in the industry, on the methods and channels of communication between the different sectors of the industry, and on productivity and costs.

22. Building research overlaps with research on civil engineering. Both of these activities extend into the field of development, which bridges the gap between research and application and consists of the work necessary effectively to apply research results to design, method and production.

Existing Facilities

23. Out of an estimated annual expenditure of £3 millions on building research (excluding the larger sums spent on research and development by manufacturers of building materials and components) roughly one half is Government expenditure; just under £1 million is spent on the Building Research Station, and the remainder of Government expenditure on grants to Research Associations and on a smaller scale, to Universities.

24. Any consideration of building research in this country must take account of the dominant rôle played by the Building Research Station. Established in 1921, it was the first in the world, and has set the pattern for the large majority of Building Research Stations which have since been established in many countries. We recognise that for the past 40 years the Station has served the country and the industry well and that it must be the foundation on which any expansion of building research is based.

25. The work of the Building Research Station is fully described in its Annual Reports and may be seen to cover practically all the field as we have described it above (paragraphs 21–22). Research on materials, structures and soil mechanics accounts for about one-third of its expenditure; research on user and physical requirements and engineering services for about one-fifth; and research on building operations and economics, and on mechanisation, for about one-sixth. About one-fifth of the Station's expenditure arises from advisory and information activities; assistance in the preparation of Standards, Codes of Practice and Building Regulations; and help with building education.

26. The remaining building research in the United Kingdom is scattered among a host of other organisations—other laboratories of the Department of Scientific and Industrial Research; Research Associations; and Universities—some of which have only a fringe interest in building and primarily serve other industries. Some of the larger contractors also have research and development facilities to serve their individual purposes.

27. Because of the very large number of organisations concerned and the difficulty of getting accurate figures from them, we cannot attempt to make any definitive estimate of the distribution of effort amongst the various fields for which we have quoted figures relating to the Building Research Station. On the whole, however, we would expect the total effort on materials, structures and soil mechanics to absorb a much higher proportion of the total than the one-third that is devoted to it by the Building Research Station. The other two broad fields would absorb correspondingly less; we would expect the effort on building operations, economics and mechanisation to be low, while, as regards user requirements, little attention has yet been paid to the large subject of the human sciences.

28. A list of relevant research and development organisations is contained in Appendix F. We also reproduce, as Appendix G, a summary review under subject headings of the research which is at present in progress in this country, while Appendix J contains a Note on the Research Officers' Investigations.

Co-ordination of Research

29. The Research Officers discerned a general desire to see some sort of co-ordination of building research in this country, although it was difficult to get those who provided the evidence to define more closely what they had in mind. We believe that research work in closely related fields is reasonably well co-ordinated, in the sense that the research workers themselves have adequate contacts between one another and are aware of other work in their own field. What seems to be lacking, however, is some formal way of surveying all that is going on, and identifying the fields in which further efforts should be made.

30. The Building Research Board has, in fact, been in the habit of doing this in order to advise effectively on the work of the Building Research Station (we noted, for example, its discussion of the industry's research needs for the next ten years in the Station's Annual Report, "Building Research 1961"). But the Board has had neither the resources nor the responsibility to do more than draw attention to needs, and to suggest how best the efforts of the Station should be deployed.

31. In his letter dated 1st July, 1963 (see Appendix B), the Minister referred to the co-ordinating rôle of the proposed Building Research and Information Association in the following terms:

> "The ultimate responsibility for co-ordinating research must rest with the Government, which must continue to undertake research directly. It is generally agreed, however, that the total volume of research is inadequate for the industry's needs; and, as Sir Harold Emmerson pointed out in his report the industry, including the associated professions, has its own views about research priorities. The Association would make available more funds for research at an increasing rate, and would provide a mechanism by which the industry would itself sponsor research projects to which it attaches high priority. My Directorate General of Research and Development will have research needs under constant review, and would be able to offer some guidance, but the Association would look first to its own members to identify the urgent needs for further research".

32. As discussed elsewhere in this report, we have reservations about the scope of " the industry " and therefore of " the Association " in this context, but we endorse this description of the responsibilities of Government and industry for the sponsoring and co-ordination of research.

Further Research Activities Required

33. Our general analysis in paragraphs 12-19 indicates that building research and development should be greatly expanded, and this was amply confirmed by the Research Officers. Although approached at short notice, all the research organisations stated that they had new projects which they would wish to start, given the necessary resources, and further, that projects in hand would bring rewarding results much earlier if a greater effort could be applied to them. Many of those in the industry who gave evidence also felt that there was a need for more research, and most of these were able to suggest appropriate fields of study.

34. All the organisations from whom we received relevant comments stressed the value of British Standards and Codes of Practice as effective methods of applying the results of research and as technical information channels for the industry and associated professions. Further research is, however, needed on many subjects if the drafting of Standards and Codes is not to be impeded.

35. The Research Officers' evidence, our statistical analysis and our collective experience all point in the same direction: that the scale of building research and development bears little relationship to the magnitude of the task of increasing the capacity of the industry. There must be a rapid expansion of the research effort over the whole range, with particular emphasis on those activities which will contribute directly to increased productivity in all sectors of the industry.

36. We are convinced that the construction industry offers great scope for operational research, which has in many industries shown the way to the efficient use of resources of all kinds. Under this general heading we see the need for studies of productivity in design and in site operations ; and also of the economics of design, bringing in all the factors which bear upon the use of resources and the ultimate cost of buildings. Particular attention must be given to the effectiveness of the machinery for taking decisions, communication and control at all levels, whether concerned with policy, planning or day to day management.

37. Research must be taken to the point of application. Quick results would flow from further development, in relation to particular circumstances, of production methods, building techniques, cost control, site mechanisation, work study methods, and the systematic survey and observation of the performance of materials and components in buildings. The scale of effort required to achieve significant benefits is beyond the resources of existing research organisations.

38. Much more needs to be done in the human sciences, especially on problems that relate to the recruitment, training and effective use of manpower, be it mental or manual. Working conditions, mobility and other factors peculiar to the industry give special importance to these subjects.

39. Increased productivity must not be achieved at the expense of quality standards, and a greater research effort is necessary into the planning and physical environment of buildings, including mechanical and electrical services. The development of new materials and techniques in design will continue to create fresh problems in meeting the functional requirements of various classes of user. For example, more research is required into sound insulation, especially in relation to modern lightweight construction and the generally increasing noise from traffic and aircraft.

40. We cannot here attempt a comprehensive account of all that needs to be done ; this we see as one of the first tasks of any new body that may be established. Our purpose is to emphasise how great, and how urgent, is the additional research effort required for an industry that has to accomplish a technological revolution within the next decade.

41. We should, however, emphasise that organisation and finance are not the only limiting factors ; there must also be an extension of research facilities, an increase in the numbers of qualified staff, and a raising of the status of building research in, for example, the Universities. These are matters requiring the co-operative efforts of Government, educational institutions and industry, in which a new body would play a leading part.

Information

Scope of the Information Function

42. Research, technical education and information are complementary activities. Technical education is the long-term function of communicating a basic technology and fostering a climate of opinion in which research is welcomed and its findings readily applied. Information is both more specific, and more immediate in application, being concerned with the industry as it exists. By definition applied research does not fulfil its purpose when the results are published in selected quarters, but only when they are applied in the relevant sectors of industry ; research therefore needs both the long-term outlet of technical education and the short-term outlet of information. There are already signs of a new look and an imminent expansion in technical education. Any new plan to support research and information activities should therefore be on a sufficient scale to enable the industry's immediate and future needs to be fully met under both these headings.

43. We regard the information function as covering all the activities through which existing technical knowledge, together with new thinking and the fruits of current research, are brought to the notice of architects, engineers, contractors and others engaged in the construction industry who can with benefit apply the results in practice. In this broad sense, " information " covers both the more passive role of supplying factual information and the more active one of advising on its application.

44. The importance of advisory and information services in the construction field arises from the advance of building technology and the

growth of new products and methods—often taken from other technologies—which have outrun the capacity of practitioners in the industry. Information and advice are needed on materials and methods; on design; on production planning and programming; on the diagnosis of defects and their remedies; and on many other matters.

The Cost of Information and Advice

45. Applied research organisations must concentrate on developing their current and future research programmes, but until the results they achieve have been adequately conveyed to, and applied by, industry, their potential value has not been realised. The extent to which existing applied research organisations are able to issue interim progress reports; redraft published results to fit them more closely to specific needs; deal with isolated problems which raise no fresh points of general interest and application; and undertake similar ancillary tasks, is limited primarily by lack of adequate funds and staff to support this work in addition to the research itself.

46. The construction industry presents particular difficulties from the points of view of information and advice. It is not only very large, but highly dispersed geographically; its site operations, of short duration, are undertaken by numerous units which vary widely in quality, size and scope. By way of illustration, we may refer to the agricultural industry, which presents the nearest structural parallel to construction. Here, it has been found necessary to establish the National Agricultural Advisory Service in order to make effective contact with individual farmers. This service employs some 1,400 advisory officers in small units scattered throughout the country and costs around £3½ millions a year; a brief description of the way it operates is contained in Appendix K.

Existing Facilities

47. Technical information relevant to building emanates from such sources as Government Departments, research stations, research associations, professional institutions, trade organisations, material producers and many more.

48. Most of the organisations undertaking research and development which we have listed in Appendix F, also perform some advisory and/or information functions. In some cases, the results of research are passed to intermediate bodies, such as development associations for the section of industry concerned; in other cases, to recognised channels of information, such as those which we have listed and described in Appendix H; and in other cases, disseminated directly to the industry at large.

49. The media employed for the dissemination of technical information vary widely according to the subject, the class of user, and such practical considerations as geography and resources. They include the following: liaison with educational institutions on the content of courses and text books; lectures, symposia and conferences; films, exhibitions and other visual displays; visits to research organisations, or sites where work is in progress; publications, including the technical press and the journals of professional institutions and trade organisations; and lastly, but of great importance, technical library and advisory services.

50. The Technical Information Service, operated by the Ministry of Public Building and Works (in London, in conjunction with the London Master Builders Association), has made a contribution in the fields of advice and information, as has the Technical Information Service of the National Federation of Building Trades Employers and its Regions, together with its Building Advisory Service. The Building Research Station undertakes much advisory work as well as publishing information. All these bodies draw on many sources for their material, and thus assist to some extent in the task of co-ordination.

51. The Building Centres also play a useful rôle in the dissemination of product information. They rely for their financing on manufacturers who rent display facilities, and in consequence the Centres do not discriminate between products or advise on application. They have endeavoured to improve standards of technical information by propaganda and by competitions.

52. The technical press and journals of the professional institutions and trade organisations provide factual information on products, development systems, costing and management, with the added stimulus of criticism. There are also a number of commercial organisations who publish comparative product information, though this is seldom based on independent evaluation.

Further Information Activities Required

53. We have described the aim of the information function as the translation into practice of existing knowledge and the fruits of new thinking and research. In relation to such a large, diverse and dispersed industry, this is an immense task. It is not simply a question of publication. Even when research has been taken to the point of application in operational trials, the results will not be adopted by the industry at large without widespread "follow-up" action and persistent pressure over a period of years.

54. The size of this problem can be illustrated by the following list of examples, given to us by the Building Research Station, of subjects on which information has been published (some comparatively recently) and on which application has been demonstrated and secured, but where there will be a continuing need for the innovations to be brought more widely into the general practice of the industry: packaging and mechanical handling of materials; organisation of concreting work; simple methods of production planning for the smaller builder; protective measures for winter work; dry linings; mechanised plastering; safe use of electricity on sites; Critical Path Method of programming.

55. In contrast to these specific needs for additional information and advice, we found that the average architect or contractor is already subjected to a barrage of printed and other technical information from a wide range of organisations, which is largely unco-ordinated and varies considerably in format, content, quality and at times credibility. The general demand from practitioners is not for more information, so much as for the sifting and co-ordination of what already exists, and its interpretation for the professional, the contractor (especially the smaller and medium-sized firm),

the foreman and the individual operative. We found that the Cement and Concrete Association had successfully adopted this approach within their own field of activity, but the scope on which it could be applied to the whole construction industry is enormous.

56. Although some of the existing information and advisory services assist in this co-ordinating and selective process, we consider that they are merely scratching the surface of the problem (as they would be the first to recognise), and that something far more ambitious is needed. We consider that a new body should be established to provide the industry with a focal point from which the whole of its complex advisory and information needs can be examined and guided.

57. We see the headquarters of the new body performing such functions as advising the industry and receiving back intelligence about its needs and problems ; guiding other organisations on the content and format of information material ; exerting a continuing pressure on research organisations to publish both interim and final results more promptly ; and conducting research into the relative efficacy and costs of different information media. Although the proposed body would undertake the preparation and dissemination of information material in selected cases, its primary aim would be to steer and supplement existing services.

58. In addition to the headquarters, we consider that regional advisory offices for the construction industry should be established, possibly modelled on the lines of the National Agricultural Advisory Service which we describe in Appendix K, though on a smaller scale and with different financial arrangements. The precise form and size of the service would need to be evolved in the light of experience over a period of years. It is recognised that the availability of qualified personnel would be a limiting factor.

59. We envisage that each regional or local office would serve as a convenient technical reference library and enquiry point for architects, contractors and others concerned with the construction industry. If their advice is to be effective, we believe that the staff should be approachable, well-versed in their respective specialisations and in constant touch with new developments ; we should expect them to be mobile and prepared to visit firms' offices and sites whenever the need arose. Each advisory centre would need to be administered by a senior qualified person of standing, who could impress on the industry the value and assistance to be derived locally from the service ; competent Headquarters backing and specialist advice would also be essential.

60. So far as product information is concerned, we see a need for a series of comparative data sheets on materials, combining commercial information on dimensions and methods of fixing, with factual data on properties ; a model for doing this in a systematic manner has been prepared by the International Council for Building Research (C.I.B.).

61. The National Council of Building Material Producers have given consideration to this problem, studied developments overseas, and consulted leading authorities in this country. Whilst appreciating the efforts of independent operators, the Council consider that they are best placed to provide a centralised, authoritative information service which is comprehensive as to content and distribution ; a note on their proposals is contained in

Appendix I to this report. We welcome their initiative and recommend that a suitable system should be developed, in consultation with the new body which we propose. Similarly, we think that the Building Centres will continue to play an important rôle, in association with the proposed new body.

62. In concluding this section of our report, we wish to emphasise that information and advisory services will achieve their maximum impact only when the industry is staffed, organised and attuned to the idea that new developments are constantly arising. Many of the delays and difficulties which are at present experienced in applying research results derive from a failure of individual firms to prepare adequately—as one of the functions of management—for the receipt of new technical information, its examination, reference to the point of decision, and application as appropriate.

Finance

Industrial Participation

63. We endorse the Minister's view that the industry should now take a substantial share in the financing and general direction of the further research and information services which we have outlined in this report. Only in this way will its practitioners become fully research conscious and concerned to apply the results urgently and effectively.

64. Apart from the cardinal need to expand the industry's total capacity for research, we consider that the establishment of fresh machinery of some kind would be an important practical and psychological measure to mark the change in financial emphasis and policy control. A new organisation with complete freedom of action in the research field could best maintain a reasonable balance between the various Government and commercial interests involved, while a focus for the industry's technical information and advisory services would, we believe, be generally welcomed.

Building and Civil Engineering

65. Our terms of reference were framed in the context of building, but it soon became clear in our discussions that the functions of research and information need to be related to the construction industry as a whole. Research projects, for example, are often of significance to both building and civil engineering, while the operation of completely separate information services could lead to overlap. The construction industry makes use of the services and products of many other industries, and their research and information services, where relevant, also need to be co-ordinated with those of the construction industry itself.

66. Some of the largest contractors and sub-contractors in the industry undertake both building and civil engineering, and indeed individual jobs cannot always be easily classified under one or other heading. We had to take account of this difficulty of definition not only in relation to the organisation of research and information activities, but particularly in relation to the necessary financial arrangements.

67. Our Working Party was composed mainly of members concerned with building rather than civil engineering, together with representatives of the Building Research Station and the Ministry of Public Building and Works. Although the Director of the Civil Engineering Research Council attended

our meetings as an assessor and gave us considerable assistance, we had no member representing civil engineering contractors as such, nor did our Research Officers approach them in that capacity. The Minister will no doubt wish to consult the industry on this question.

68. We hope that general agreement will be forthcoming to the proposals which follow, not only because we are convinced that it is right to treat the construction industry as a whole for this purpose, but also because we wish to avoid a situation in which individual sponsors feel obliged to choose between the existing Civil Engineering Research Council and a new research organisation with interests confined to building.

Methods of Payment

69. The Civil Engineering Research Council (which is likely to become a Research Association early in 1964), and several existing research associations concerned with different aspects of the construction industry, rely partly for finance on voluntary subscriptions and covenants, which carry the right to membership and the privileged receipt of information material; they also receive a grant from the Department of Scientific and Industrial Research. The Working Party soon concluded that any new research body for the construction industry as a whole could not, however, operate satisfactorily on a voluntary system of financing; the industry is much too large and too diverse, and those less progressive and smaller firms who could most benefit from the service would be the least likely to join. It would also be difficult and undesirable to limit the dissemination of information to a selected membership list.

70. We consider it essential that the research effort, the advisory service and the preparation of information material should be conducted against the background of an assured long-term income, sufficiently broadly-based as to eliminate constant fluctuations in the scale of effort and undue pressure from narrow vested interests. The magnitude of the sums to be raised, which will run into millions of pounds per annum, also suggests that only a compulsory levy on the whole of the industry would produce the necessary amount of money on a reasonably equitable basis.

71. With small and close-knit industries, such compulsory schemes can be applied by the industries themselves through, for example, trade associations. There seems no prospect of organising such a levy in the construction industry, however, without resort to legislation.

Legislative Action

72. While the introduction of completely new legislation would enable a tailor-made scheme to be devised for the industry, it could clearly delay the setting up of the proposed new organisation by months, if not years, and we had hoped to find a simpler and quicker solution to the problem of finance. We have therefore considered the possibility of using the Industrial Organisation and Development Act of 1947, in which we have had valuable assistance from the assessor on the Working Party from the Department of Scientific and Industrial Research.

73. Under Sections 1 and 4 of this Act, the Minister of Public Building and Works (among others) is empowered to establish a development council, and to impose statutory levies, provided, inter alia, that he is satisfied that this is " desired by a substantial number of the persons engaged in the industry ". The functions which may be assigned to development councils

are listed in the First Schedule to the Act, and include promoting or undertaking scientific research, promoting or undertaking enquiry as to materials and equipment and as to methods of production, management and labour utilisation; advising on any matters relating to the industry; and undertaking arrangements for making available information obtained, and for advising on matters with which the council are concerned in the exercise of any of their functions.

74. It therefore seems clear that a new research and information body for the construction industry could be set up and financed by a statutory levy, under the terms of Sections 1 and 4 of the 1947 Act, if a development council were first to be established.

75. Alternatively, Section 9 of the same 1947 Act empowers the Minister to impose a levy on the industry for the purpose of:

(*a*) Scientific Research

(*b*) Promotion of export trade or,

(*c*) The improvement of design

providing that there were a body capable of carrying out that purpose satisfactorily.

76. Before making any Order it would be necessary for the Minister to consult "any organisation appearing to him to be representative of substantial numbers of persons carrying on business in the industry and such organisations representative of persons employed in the industry as appear to the Minister to be appropriate" (including, of course, the civil engineering sector if the levy is to cover construction as a whole); to satisfy himself that "the incidence of the charges as between different classes of undertakings in the industry will be in accordance with a fair principle"; and to obtain an affirmative resolution of each House of Parliament.

77. While, however, Section 9 of the 1947 Act gives the Minister the power in these circumstances to impose a statutory levy without first establishing a development council for the industry, the provisions of this Section appear to be unduly restrictive for our purpose, notably the reference to "scientific" research and the absence of any clause covering information explicitly. The new organisation which we consider necessary for the construction industry should put the emphasis initially on advice and information, rather than on research, and should also interpret the latter term very broadly.

78. We have therefore been faced with a choice between recommending entirely fresh legislation, which would take too long; the use of Sections 1 and 4 of the existing 1947 Act, which would involve the establishment of a development council for the industry; and the use of Section 9 of the same Act, which would be too restrictive.

79. Unless the Minister can secure the necessary agreement to a development council, we conclude that the long-term solution must involve fresh legislation, but we recommend the raising of a levy under Section 9 as an interim measure. In view of the limited purposes to which such a levy could be put, we should hope that additional finance, with few strings, would be forthcoming from the Government, Local Authorities and indeed, industry, during the interim period.

Detailed Administration

80. Three questions arise under this heading:—

(*a*) Who is to pay the levy?

(*b*) How should it be assessed?

(*c*) How is the levy to be collected?

81. The Industrial Organisation and Development Act, 1947, provides that levies may be imposed "on persons carrying on business in the industry, or on persons carrying on business consisting wholly or partly in the production of, or dealing in, any of the materials of the industry". It has, however, been suggested to us that since the cost of any such levy would be an overhead charge it would be best to attach some form of "stamp duty" to contracts or final accounts.

82. We consider that any such arrangement would be generally unacceptable, even in the context of fresh legislation, and since our short-term proposals are based on the 1947 Act, we have assumed that the levy should fall on the industry itself.

83. We have been unable, in the time available, to discover any universally satisfactory basis for assessing levies, and consider that a variety of methods will be required. So far as contractors and sub-contractors are concerned, the choice appears to rest between a percentage charge based on turnover, or on final accounts, and a per-capita levy on personnel.

84. We consider that the professions and others associated with the industry, such as building material producers and manufacturers of construction equipment, should also participate, and should contribute on an equitable basis. Many members of the professions, however, are employed by the Government, Local Authorities or contractors, and would be covered by their contributions or levies; others are engaged in small practices from which it would be uneconomic to collect levies; and several of the professions concerned with construction are also involved in other industries or activities.

85. Any estimate of the sum to be raised must be somewhat arbitrary. The Minister has referred to an annual budget "of at least £500,000 in five years" (see Appendix A). We consider that although the necessary expansion will be conditioned by the rate at which research facilities can be augmented, and qualified personnel recruited, the target should be put considerably higher—say, at £3 millions within five years and at upwards of £5 millions in the longer term.

86. We suggest that the aim should be to raise at least £500,000 from the industry in the first year of operation, to which would be added the Minister's offer of £150,000 referred to in Appendix A, and the grant of up to £80,000 which the Civil Engineering Research Council receives from the Department of Scientific and Industrial Research, making a total of, say, £750,000. This would need to cover research and information concerned with building and civil engineering.

87. An initial levy of half a million pounds would be equivalent to about 0·02 per cent of the construction industry's gross product or, alternatively, a per capita charge of approximately 10s. a year. The eventual sum

to be collected should, however, be considerably more, depending on the organisation's success in attracting qualified staff, inducing other bodies to expand their capacity, and securing the industry's confidence.

88. In order to minimise the administrative work involved in collecting the levy, it might be expedient to exempt one-man and other very small firms. Exempted firms might, however, be charged a fee for any services of which they take advantage.

89. It may be possible to achieve further administrative economies by collecting the levy through the machinery established for the Industrial Training Levy and/or the Holidays with Pay Scheme. We consider, however, that the responsibility for maintaining the appropriate register of contributors should remain with the Ministry of Public Building and Works, which would also be accountable for the levy fund.

90. Some of the administrative implications of a statutory levy for both the Ministry and industry may conveniently be mentioned here:

(*a*) Statutory returns from the whole of the construction industry (including nil returns) would be required.

(*b*) Proceeds would be paid into a public fund or account, administered by the Ministry of Public Building and Works.

(*c*) The accounts of the fund would be audited by the Exchequer and Audit Department.

(*d*) Money would be issued from the fund to the body established to carry out authorised functions.

(*e*) The accounts of this body would have to be audited and submitted to the Ministry and to Parliament.

(*f*) The machinery required to operate the levy would need to be set out in an Order; this would also need to define the scope of the industry for the present purpose.

91. A fundamental legal principle of the 1947 Act is that the levy must be seen to be fair in its incidence, and must be enforced without discrimination.

Constitution

92. This Working Party was established to consider the Minister's proposal to set up a Building Research and Information Association, jointly financed initially by the Government and industry, to undertake the activities outlined in Appendices A and B.

93. It will be apparent from earlier sections of our report that we agree in principle with the establishment of an Association with research and information responsibilities, in the field of building. We are convinced, however, that the only satisfactory way of financing such a body would be by statutory levy, and we consider that the industry cannot, for this purpose, be clearly divided as between building and civil engineering (including, in each case, the associated engineering services).

94. In this situation, we are obliged to venture outside our strict terms of reference and to recommend, also, the establishment of a second new body which would receive and allocate funds for research and information in respect of the construction industry as a whole. We suggest that this body, which would be senior to both the proposed Building Research and Information Association and the existing Civil Engineering Research Council, should be known as the Construction Industry Research and Information Commission. (The respective relationships are shown schematically in Appendix L).

95. The Commission would be governed by a Council representative of the industry (including the professions); the Ministry of Public Building and Works; the Department of Scientific and Industrial Research; research organisations (including the Universities); trade unions; building owners; and manufacturers and suppliers. We suggest that in the interests of co-ordination, a proportion of the Council members should be drawn from the Council of the proposed Building Research and Information Association and from the Civil Engineering Research Council.

96. The main functions of the proposed Construction Industry Research and Information Commission would be to survey the construction industry's strategic needs and capacity for research and information activities; to advise the Minister, from time to time, upon the income to be raised by levy; broadly to apportion the available financial resources between the proposed Building Research and Information Association, the Civil Engineering Research Council and other research organisations; and to co-ordinate their activities.

97. We have considered whether the proposed Commission should undertake executive functions in the research, information or advisory fields. While there are areas of overlap between building and civil engineering, we doubt whether much would be gained by reserving particular subjects or activities to the senior body.

98. We should expect the proposed Building Research and Information Association and the Civil Engineering Research Council to work closely together in planning their research programmes; in executing projects with a common interest; and in exchanging information material. From an organisational point of view, the information problems in the two fields are, however, dissimilar: civil engineering work is undertaken mainly by 650 relatively large firms, whereas building is spread over about 90,000 contractors and sub-contractors, many of them being very small firms. In addition, civil engineering is the concern of the engineer, while building spreads over many professions. We should, therefore, expect the proposed Commission to review the situation and to make suitable arrangements with the research organisations and other bodies.

99. We have also given some thought to the desirability or otherwise of linking research and information at the executive level. In his first letter (Appendix A), the Minister proposed that the Association should simply sponsor, and not undertake research; his second letter (Appendix B), however, suggests that it would have freedom of action in the long-term, and from the point of view of attracting qualified staff we consider this

essential. Nevertheless, we should expect that in the early days the Association's executive duties would be heavily weighted in the direction of information and advice.

100. We recognise that the combination of research and information activities in the same body, even though organised in two distinct branches, will necessitate a blending of different abilities and attitudes on the part of the staff, as well as a careful balance of emphasis between the periphery and the centre. We think this is all to the good ; there are many sectional interests in the construction industry, and we want both the proposed Commission and the Association to be unifying influences.

101. Staff engaged in an advisory service, for example, should be aware of current and projected research as well as existing information material ; conversely they should "feed back" intelligence to the centre about the state of all sectors of the industry and their day to day problems. In the same way, the preparation of information material should be a co-operative undertaking between technical editors, illustrators and similar specialists on the one hand, and research trained staff who can assess and interpret research results, on the other hand.

Interim Arrangements

102. We are particularly concerned that the financial support of existing research organisations in the construction field should not be prejudiced during the period that our recommendations are being implemented.

Acknowledgements

103. We are indebted to the many organisations and individuals who have assisted us in our work by giving oral or written evidence, often at short notice. We also wish to record our sincere thanks to our Research Officers and Assessors and particularly to the Secretariat, including the clerical staff, for their devoted assistance in marshalling the evidence in the preparation of this report. In our anxiety to achieve, in the very limited time available, a comprehensive review of the current situation, we have inevitably made considerable demands upon them. We recognise that we have been most fortunate in those who have assisted us administratively in our work.

P. H. P. Bennett.
N. S. Farrow.
P. W. Grafton.
E. P. Lawrence.
D. C. Mallam.

D. E. Woodbine Parish,
Chairman.

11th December, 1963.

Summary of Conclusions and Recommendations

1. There is a need for more research, both generally and in fields which we have specified, in addition to some focal point from which existing research activities can be considered as a whole. (Paragraphs 12–19, 29–41.)

2. The industry needs central and regional advisory services; the results of research and other technical literature specially drafted for different classes of user; comparative product information; and other measures to sift, classify, co-ordinate and apply the present flow of technical information, which is excessive in volume but uneven in quality and coverage. (Paragraphs 53–62.)

3. The industry should take a greater share in the financing and direction of research and information; for this purpose, subject to consultation with civil engineering interests, the construction industry should be treated as a whole. (Paragraphs 63–68.)

4. A statutory levy covering research and information activities, broadly interpreted, should be raised from the industry; this would necessitate either a development council or fresh legislation. (Paragraphs 69–74.)

5. Unless a development council is established, a statutory levy of more limited scope should be raised from the industry under Section 9 of the Industrial Organisation and Development Act, 1947 as an interim measure; it is hoped that this would be supplemented by contributions from Government, Local Authorities and industry. (Paragraphs 75–79.)

6. The levy, and related income, should be met on an equitable basis by contractors, sub-contractors, professions and others associated with the industry, but not directly by clients. (Paragraphs 80–84.)

7. The annual sum to be raised from the industry should be £500,000 in the first year, to which would be added the Minister's offer of £150,000, and the grant of up to £80,000 which the Civil Engineering Research Council receives from the Department of Scientific and Industrial Research; the total annual budget should build up to £3 millions within five years, and upwards of £5 millions in the longer-term. (Paragraphs 85–87.)

8. To reduce the administrative work involved in collecting the levy it might be expedient to grant exemption to small firms (who could perhaps pay for any services of which they took advantage), and to utilise existing collection machinery. (Paragraphs 88–89.)

9. The raising of a statutory levy would necessitate certain accounting and enforcement measures. (Paragraphs 90–91.)

10. A Construction Industry Research and Information Commission, with a widely representative membership, should be established; its main functions should be to survey the construction industry's strategic research and information needs and capacity, to advise the Minister on the income to be raised by levy, broadly to apportion the available financial resources between the relevant research organisations, and to co-ordinate their activities. (Paragraphs 92–98.)

11. A Building Research and Information Association should also be established, under the proposed Commission, with executive responsibilities in the fields of building research, information and advice. (Paragraphs 92–101.)

12. The financial support of existing research organisations in the construction field should not be prejudiced during the period that our recommendations are being implemented. (Paragraph 102.)

Appendix A

Ministry of Public Building and Works,
Lambeth Bridge House,
Albert Embankment,
London, S.E.1.

22nd May, 1963.

The building industry must meet the challenge of increasing demand for massive building programmes in many fields.

If building investment, both social and economic, is to grow quickly enough to meet the nation's needs the industry will have to increase its output and its productivity at an unprecedented rate. Growth at this rate calls for a heavy research effort and for intensive measures to secure the dissemination of the best technical information throughout the industry.

I know there is an increasing awareness in the industry itself of the urgent need for increased technological competence. The industry's decision to support a major research project on communications in the building process is an excellent indication of this forward looking attitude.

We must act now to increase the amount of research. It is difficult to obtain precise figures, because many firms and organisations carry out internal studies and some organisations do this on a voluntary basis. But on the best information available to me the annual expenditure on research and development by builders and the associated professions is of the order of £1½ to £2 million. The Government's contribution is something like the same amount each year. In the technical information field the Government is now spending over £165,000 a year, which is probably more than is spent annually on all the non-Government information services in the industry.

The Government is willing to play its part in increasing the total effort put into research and the dissemination of information. But we cannot succeed in getting results unless the industry also plays a larger part in both these fields of activity. Only in this way will we be able to ensure that research is planned so as to provide the maximum benefit for the industry, and information services are designed to meet its real needs.

I am therefore writing to propose the establishment of a Building Research and Information Association. Its constitution would follow the pattern of other industrial research associations, such as the Civil Engineering Research Council. On its management body, however, which would represent the building industry and Government Departments, my Ministry would be strongly represented because of the close concern of my Directorate General of Research and Development with research and information for the industry.

The Association would not directly undertake research projects. Its function would be to formulate a programme of research, with priorities carefully allocated; and to commission projects from a variety of agencies including the Building Research Station, the Universities and other Research Associations. The possible choice of research projects is very large indeed, and I attach importance to the industry playing its part in guiding the direction of research.

In the information field the Association would have executive functions: it would take steps to repair current deficiencies in information, and it would act as a focus of technical advice. For this purpose it would no doubt have to operate in various places throughout the country, for example in association with the Building Centres.

The Association would be a partnership between the Government and the industry. The Government would be willing to contribute up to £150,000 a year for three years if the industry would match this contribution £1 for £1. This offer is conditional on a minimum contribution by the industry of £50,000 each year. The Government's contribution after the first three years would be reviewed towards the end of this period, but the Government would expect the Association's annual budget to build up to a figure of at least £500,000 in five years.

I believe that an Association on these lines would be of the greatest possible benefit to the building industry, which I am sure is as anxious as the Government that building output and productivity should grow quickly to meet rising demand. I hope, therefore, that your organisation will accept the Government's offer, and co-operate with us in setting up a Building Research and Information Association on the lines proposed in this letter.

I would hope that your organisation will feel able to accept this offer in principle by the 1st July and in particular that it will indicate that it is prepared to co-operate with the other bodies to whom this letter is addressed in seeking to raise the necessary funds.

GEOFFREY RIPPON.

The President.

Royal Institute of British Achitects.
National Federation of Building Trades Employers.
The Royal Institution of Chartered Surveyors.
National Council of Building Material Producers.
Federation of Associations of Specialists and Sub-Contractors.
National Federation of Builders' and Plumbers' Merchants.
The Federation of Manufacturers of Construction Equipment.
Committee of Associations of Specialist Engineering Contractors.
The Association of Consulting Engineers.

Appendix B

Ministry of Public Building and Works,
Lambeth Bridge House,
Albert Embankment,
London, S.E.1.

1st July, 1963.

Thank you for your letter of the 12th June concerning my proposals for setting up a Building Research and Information Association. I am pleased to hear that the Federation agree in principle with the main objects of the proposals. I appreciate that you will wish to discuss them in your National Council, and I will hope to hear from you shortly after its next meeting.

The conjunction of research and information is not novel. Other industrial Research Associations already combine both functions satisfactorily and I hope that your Federation will agree that the Building Research and Information Association should follow the pattern established for other research associations.

Final arrangements for the Association must be the subject of agreement between all those concerned, but in view of what you say in your letter it may be helpful if at this stage I add a little to the sketch I have already outlined.

Research.—The ultimate responsibility for co-ordinating research must rest with the Government, which must continue to undertake research directly. It is generally agreed, however, that the total volume of research is inadequate for industry's needs ; and, as Sir Harold Emmerson pointed out in his report, the industry, including the associated professions, has its own views about research priorities. The Association would make available more funds for research at an increasing rate, and would provide a mechanism by which the industry could itself sponsor research projects to which it attaches high priority. My Directorate General of Research and Development will have research needs under constant review, and would be able to offer some guidance, but the Association would look first to its own members to identify the urgent needs for further research.

At least at the start the Association would best operate by commissioning research projects from existing research stations and associations and from the universities. The study of "Communications in the Building Industry" commissioned from the Tavistock Institute of Human Relations and the Institute of Operational Research is a good example of the kind of project I should expect the Association to sponsor. Sir Harold Emmerson mentioned the need for more research to be done on such matters as site organisation, work study, cost control, conditions of employment and human relations. Examples of other projects which might be undertaken are studies of the effect of variety on productivity and cost in all aspects of building work and the savings which can be obtained in office, factory and site by standardisation leading to repetitive operations ; of the tolerances to be allowed for materials and components of different kinds ; and of the effective use of mechanical plant in building and how its use is affected by the design of buildings and their components. The choice of particular projects, however, and the settlement of priorities between them, would have to be left to the Association.

Information.—Here the first need, as I see it, is to ensure that all parts of the industry are better informed about existing technical knowledge. If the industry is to make the best use of what is already known it ought to participate in the process of disseminating information. The methods by which the process can be carried out are well established. I envisage that a technical advisory service would operate both centrally and regionally, able to give advice to architects, builders and others on solutions already found to many technical problems. The Association would be expected to maintain close contact with Building Centres but it would not have direct responsibility for these. It would also advise manufacturers and suppliers on how to improve the quality of their product information. It would maintain contact with all sources of technical information in building, identify new needs for technical information and respond quickly by helping the industry and Government to satisfy these needs. The Association would also be concerned with the organisation of lectures, film shows, exhibitions and conferences, particularly on a regional basis.

Organisation.—The Association should follow the general pattern of grant-aided Research Associations. Its governing body should be a Council, on which the contributing Institutions and Federations are represented, as well as my Ministry and the Department of Scientific and Industrial Research. Policy decisions, financial control, and the selection of staff would rest with this Council.

In the first instance a Director should be appointed to deal with both research and information, and it would clearly be important to secure the services of a first rate man for this post. He would be supported by a small highly qualified staff on the research side, and a larger staff on the information side, where most of the executive work would lie.

I do not wish to be more precise than this at the present stage, since details must be worked out in consultation with all participants. But I trust that this information will be sufficient to enable the Federation to accept my proposals in principle. I hope to have a favourable reply from you soon.

I am sending copies of this letter to the recipients of my letter of the 22nd May.

GEOFFREY RIPPON.

The President,
National Federation of Building Trades Employers.

Appendix C

LIST OF ORGANISATIONS APPROACHED BY THE RESEARCH OFFICERS

I

Association of Consulting Engineers.
Illuminating Engineering Society.
Incorporated Association of Architects & Surveyors.
Institute of Builders.
Institute of Housing.
Institute of Quantity Surveyors.
Institution of Electrical Engineers.
Institution of Heating & Ventilating Engineers.
Institution of Mechanical Engineers.
Institution of Structural Engineers.
Modular Society.
Plastics Institute.
Royal Incorporation of Architects in Scotland.
Royal Institute of British Architects.
The Royal Institution of Chartered Surveyors.
The Royal Institution of Chartered Surveyors (Scottish Branch).
Town Planning Institute.

II

British Ceramic Research Association.
British Coal Utilisation Research Association.
British Electrical & Allied Industries Research Association.
British Iron & Steel Research Association.
British Non-Ferrous Metals Research Association.
British Standards Institution.
Building Research Station.
Chalk, Lime & Allied Industries Research Association.
Fire Research Association.
Forest Products Research Laboratory.
Heating & Ventilating Research Association.
Timber Research & Development Association.
Research Association of British Paint, Varnish & Colour Manufacturers.
Rubber & Plastics Research Association of Great Britain.

III

Cement & Concrete Association.
Ellis Research & Testing Laboratories.
Joint Committee on Structural Concrete.
National Industrial Fuel Efficiency Service.

Research Division of the Gas Council.

IV

Architectural Association (London), School of Architecture.
Heriot-Watt College (Edinburgh), Department of Building.
The Manchester College of Science and Technology, Department of Building.
Royal College of Science and Technology, Glasgow.
University of Aberdeen, Marischal College.
University of Cambridge.
University of Edinburgh, Department of Architecture and Civil Engineering.
University of Glasgow.
University of Liverpool, The Liverpool School of Architecture.
University of London, Bartlett School of Architecture.
University of Newcastle-upon-Tyne, School of Architecture.
University of St. Andrews.
University of Sheffield, Department of Architecture.

V

The Building Centre, London.
Manchester Building Centre.
The Scottish Building Centre.

VI

Department of Scientific and Industrial Research Information Division.
National Agricultural Advisory Service (Ministry of Agriculture, Fisheries & Food).

VII

The Editor, Architect and Building News.
The Editor, Architects' Journal.
The Editor, Builder.
The Editor, Building Engineer.
The Editor, Building Industry News.
The Editor, Contract Journal.
The Editor, Illustrated Carpenter and Builder.

VIII

Architectural Metal Craftsmen's Association.
Association of Constructional Floor Specialists.
Association of Flooring Contractors.
Association of Piling & Concrete Specialists.
British Cast Concrete Federation.
British Constructional Steelwork Association.
British Institute of Hardwood Flooring Specialists.
Cast Stone & Concrete Federation.
Coal Utilisation Council.
Coal Utilisation Council (Scotland).
Committee of Associations of Specialist Engineering Contractors.
Decorative Marble Federation.
British Electrical Development Association.
Electrical Contractors Association Incorporated.
The Electrical Contractors Association of Scotland.
Federation of Associations of Specialists and Sub-Contractors.
Federation of Manufacturers of Construction Equipment.
Federation of Master Builders.
Federation of Registered House Builders.
Felt Roofing Contractors Advisory Board.
Fencing Contractors Association.
Floor Covering Contractors Association.
Heating and Ventilating Contractors' Association.
Mastic Asphalt Employers Federation.
Metal Fixing Association for Building Insulation.
Metal Roofing Contractors Association.
Metal Window Association Ltd.
National Association of Lift-Makers.
National Association of Shopfitters.
National Coal Board (Scottish Division H.Q.).
National Council of Building Material Producers.
National Federation of Builders' & Plumbers' Merchants.
National Federation of Building Trades Employers.
National Federation of Demolition Contractors.
National Federation of Master Painters and Decorators of England & Wales.
National Federation of Master Painters in Scotland.
National Federation of Master Steeplejacks & Lightning Conductor Engineers.
National Federation of Plumbers and Domestic Engineers (Employers).
National Federation of Roofing Contractors.
National Federation of Terrazzo-Mosaic Specialists.
National Master Tile Fixers Association.
Patent Glazing Conference.
The Plate Glass Association.
Reinforcement Steel Engineers Association.
Scottish Association of Heating & Ventilation & Domestic Engineering Employers.
Scottish Association of Paint Manufacturers.
Scottish Employers Council for the Clay Industries.
Scottish Federation of Plumbers' and Domestic Engineers' (Employers') Association.
Scottish National Building Trades Federation (Employers).
The Scottish Plant Owners Association.
Scottish Precast Manufacturers' Association.
Society of Railing and Balustrade Makers.

IX

Architects Co-Partnership.
Associated Architects and Consultants.
T. P. Bennett & Son.
Building Design Partnership.
Crosher & James.
Davis, Belfield & Everest.
Gardiner & Theobald.
Gleeds.
Handisyde & Taylor.
Harris & Partners.
Edmund Kirby & Sons.
Alister MacDonald & Partners.
Robert Matthew, Johnson-Marshall, & Partners.
Thomas Mitchell & Partners.
Cyril Sweett & Partners.
Yorke, Rosenberg & Mardall.
Young & Brown.

X

Percy Bilton Ltd.
Henry Boot & Sons Ltd.
Bovis Ltd.
Richard Costain Ltd.
William Cowlin Ltd.
Demolition and Construction Co. Ltd.
Melville Dundas & Whitson Ltd.
Howard Farrow Ltd.
Ford & Walton Ltd.
W. & C. French Ltd.
J. Gerrard & Sons Ltd.
Gilbert-Ash Ltd.
M. J. Gleeson (Contractors) Ltd.
Higgs & Hill Ltd.
Holland & Hannen and Cubitts Ltd.
Holloway Bros. (London) Ltd.
Humphreys Ltd.
J. Jarvis & Sons Ltd.
Kirk & Kirk Ltd.
John Laing Research & Development Ltd.
Sir Robert Lloyd & Co. Ltd.
Y. J. Lovell & Sons Ltd.
Sir Robert McAlpine & Sons Ltd.
McLaughlin & Harvey Ltd.
James Miller & Partners Ltd.
Mills Scaffold Co. Ltd.
F. G. Minter Ltd.
A. Monk & Co. Ltd.
William Moss & Sons Ltd.
John Mowlem & Co. Ltd.
Sir Lindsay Parkinson & Co. Ltd.
E. Pollard & Co. Ltd.
Rush & Tompkins Ltd.
Scaffolding (Great Britain) Ltd.
Arthur Scull & Sons Ltd.
The Shepherd Group Ltd.
W. J. Simms, Sons & Cooke Ltd.
The Stone Firms Ltd.
The Taylor Woodrow Group.
W. A. Telling Ltd.
Tersons Ltd.
Token Construction Co. Ltd.
William Townson & Sons Ltd.
Trollope & Colls Ltd.
Unit Construction Co. Ltd.
Wates Ltd.
George Wimpey & Co. Ltd.
W. J. Whittall & Son Ltd.

XI

North of Scotland Hydro-Electric Board.
Scottish Special Housing Association Ltd.

XII

National Federation of Building Trades Operatives.

Appendix D

STANDARD INDUSTRIAL CLASSIFICATION

(Revised 1958)

Published by the Central Statistical Office

ORDER XVII—CONSTRUCTION

500 *Construction*

Erecting and repairing buildings of all types. Constructing and repairing roads and bridges ; erecting steel and reinforced concrete structures ; other civil engineering work such as laying sewers and gas mains, erecting overhead line supports and aerial masts, opencast coal mining, etc. The building and civil engineering establishments of (Defence and other) Government Departments and of local authorities are included.

Establishments specialising in demolition work or in sections of construction work such as asphalting, electrical wiring, flooring, glazing, installing heating and ventilating apparatus, painting, plastering, plumbing, roofing. The hiring of contractors' plant and scaffolding is included.

Appendix E

Extract from Treasury Bulletin for Industry dated February 1963

Research in Private Industry

	Expenditure £m.	Qualified manpower on research and development	Average expenditure per qualified employee	Average expenditure per employee
	1961–2	000	£000	£
Food, drink and tobacco	7·1	1·0	7·2	13
Chemical and allied industries ...	39·7	6·1	6·5	116
Mineral oil refining...	6·0	0·8	7·8	207
Metal manufacture	10·0	1·6	6·4	53
Mechanical engineering and ship-building	33·7	3·6	9·4	35
Scientific instruments	9·2	1·1	8·3	87
Electrical engineering	36·2	3·7	9·8	88
Electronics	49·9	4·7	10·7	182
Motor vehicles, locomotives etc. ...	9·8	0·6	15·2	23
Textiles, leather and leather goods...	8·7	1·2	7·3	9
Aircraft	140·6	4·4	32·2	506
All other manufacturing industries	13·5	2·0	6·9	14
Construction	1·5	0·3	4·3	2
Total Private industry*	365·7	30·9	11·8	54

* Establishments with over 100 employees.

Appendix F

ORGANISATIONS CONDUCTING RESEARCH AND DEVELOPMENT ACTIVITIES IN BUILDING

This list makes no claim to be comprehensive and does not, for example, include the R. & D. departments of building contractors nor the manufacturers of building materials and components. It does however give an indication that a very considerable number of organisations are concerned.

A. *The Department of Scientific and Industrial Research* is the major official organisation and its work, covering a wide field in the context of the building industry, is conducted at the following of its stations:—

Building Research Station.
Forest Products Research Laboratory.
Fire Research Station (through Joint Fire Research Organisation).
National Physical Laboratory.
National Chemical Laboratory.
Road Research Laboratory.

B. *Other Government Departments* which engage in research and development work in this context include:—

Ministry of Public Building and Works.
Ministry of Housing and Local Government.
Ministry of Health.
Ministry of Education.
Post Office.
Scottish Development Department.

C. The *Research Associations* receiving grants from D.S.I.R. whose work relates to a varying extent to the building industry's problems, include:—

British Cast Iron Research Association.
British Ceramic Research Association.
British Coal Utilisation Research Association.
British Electrical and Allied Industries Research Association.
British Glass Industry Research Association.
British Iron and Steel Research Association.
British Non-Ferrous Metals Research Association.
British Welding Research Association.
Chalk, Lime and Allied Industries Research Association.
Civil Engineering Research Council.
Heating and Ventilating Research Association.
Research Association of British Paint, Colour and Varnish Manufacturers.
Research Council of the British Whiting Federation.
Rubber & Plastics Research Association.
Timber Research and Development Association.

D. (1) Of the *Universities and Colleges of Technology*, the following are active in the Departments of Building and Building Science:—

Royal College of Science and Technology, Glasgow.
Liverpool University.
Sheffield University.
Manchester College of Science and Technology.
Brixton School of Building.
Heriot-Watt College, Edinburgh.

(2) Most Universities, Colleges of Technology and of Advanced Technology have some work in progress in their departments of Building or Civil Engineering in the fields of Structures or Soil Mechanics.

(3) Research is developing strongly in planning and environmental physics in the Departments of Architecture of the Universities of Cambridge, Edinburgh, Liverpool, Newcastle, Sheffield and London (U.C.L.).

(4) Work on the basic properties of building materials is undertaken in the Departments of Physics and of Chemistry in the Universities of Aberdeen, Liverpool, Southampton and London (Birkbeck).

E. In addition to the above, research work is also conducted by the professional institutions including particularly the Royal Institute of British Architects, The Royal Institution of Chartered Surveyors and the Institute of Builders as well as other hodies. The work of the Cement and Concrete Association, the Joint Committee on Structural Concrete, and of the Watson House Gas Research Council must also be included in the overall list.

Appendix G

BUILDING RESEARCH AND DEVELOPMENT

A SUMMARY REVIEW OF RESEARCH IN PROGRESS

(Prepared by Mr. K. Alsop, Building Research Station)

INTRODUCTION

1. Building research and development is conducted in Government departments and research laboratories and in local authority consortia ; grant-aided research associations ; independent research associations ; universities, colleges of advanced technology and technical colleges ; and private firms. The bulk of the work is paid for by the body that carries it out, but some is financed by other bodies.

2. Main trends in recent years have been the increasing influence of development groups both in central and local government ; the readiness of bodies like the National Joint Council for the Building Industry to foster and to pay for research ; the establishment of schools of building or building science in universities, with consequent starting up of research activities ; and increasing international activity.

3. This paper attempts to summarise the current work in all the organisations mentioned in the first paragraph except the private firms and has all the defects that would be expected of such a review. In particular, detail is largely missing, and the paper is divided into sections that are by no means as clear cut as the headings would suggest.

4. Although there are several references below to the work of the Building Research Station, a brief summary of its research programme is given in paragraph 41 of this appendix. This is followed by notes on the work of the Development Groups.

BUILDING OPERATIONS AND COSTS

5. The main research on building operations and costs is carried out at the Building Research Station (B.R.S.), where the effort devoted to this subject has increased in recent years. Work on operational and economic aspects of buildings has also been increasing outside the Station ; until a few years ago there were few research projects undertaken for the benefit of the industry, but several important studies are now in progress. Amongst these are the study of the design economics of removable partitions being done by the Department of Building of the Manchester College of Science and Technology and financed by B.R.S. ; an investigation by the same body into the structure and economy of the building industry, financed by D.S.I.R. ; and a study of communications between the principals engaged in the building industry which is being sponsored by the Communications Research Project Trust and undertaken jointly by the Tavistock Institute of Human Relations and the Institute of Operational Research —this was initiated by the National Joint Consultative Committee and is now supported financially by both D.S.I.R. and M.P.B. & W. The Pilkington Research Unit at Liverpool University in their studies of building types is investigating various problems in the field of design economics.

6. The research programme on building operations and costs at B.R.S. covers four main groups of topics. The first is concerned with the economic consequences of alternative design decisions. Examples are the work on "costs in use", a technique for predicting the consequential costs of design decisions, allowance being made not only for costs of construction but also for subsequent running and maintenance costs. The main emphasis is on problems in the hospital and urban planning fields and one design study is being made with the Ministry of Health. Secondly, there is a group of problems concerned with the production aspects of building. Included are studies of the technical aspects of individual operations such as mechanical plastering, the laying of dry floor screeds, the

use of network analysis of operations for planning and controlling work and the use of network analysis applied to the process of building from the initial decision to build right through to the completion of construction. A third group concerns the interplay between design and production and includes the development of the operational bill of quantities and the development of a system of site vertical casting of large concrete units for construction of flats. It also includes the development of a system for assessing economically different systems of construction. Finally, there is work dealing with operative skills in the building industry which will branch out into some wider studies relevant to recruitment and training. In this group falls the work with the Institute of Builders of site management and the study of operative skills supported by the National Joint Council for the Building Industry.

MECHANICAL PLANT

7. Much of the work at B.R.S. is at present concerned with the process of building with large heavy elements. Study is being made of the requirements for handling these elements and of the methods of production. Other work concerns the use of electricity on building sites; a consideration of handling problems involved in established prefabricated building systems such as CLASP and NENK, and the development of methods for measuring the mechanical performance, handiness and noise emission from road breakers. Work on noise from machinery is in progress at the National Engineering Laboratory. Work in progress at the Road Research Laboratory includes the development of a new type of vibrating screed board, a dumper that spreads as well as transports concrete and a hydraulically operated earth boring machine.

REQUIREMENTS

8. This section deals with matters in which the design of the building is related to the needs and habits of the user. Part of the work is concerned with the needs and preferences of the occupant of a building and with his reactions to the environment the building provides; part is concerned with the means whereby the physical environment is provided.

User requirements

9. Studies are in hand under the Medical Research Council of the environmental factors that affect health, comfort and efficiency.* In the field of lighting, the Medical Research Council has an Applied Psychology Research Unit and Occupational Optics Unit that are contributing to an understanding of the way in which levels of illumination, flicker, glare, etc., affect visual comfort, acuity and efficiency. B.R.S. is doing a good deal of complementary work. The Applied Psychology Research Unit of the M.R.C. and the University of Glasgow are working on the effects of noise on the performance of skilled tasks. B.R.S. is studying people's response to noise in an effort to identify the main characteristics of noise nuisance.

10. Studies of interactions within small groups have a bearing on housing schemes and are being studied by the Tavistock Institute of Human Relations and Birmingham University. B.R.S. work in the user field in dwellings is now concerned with circulation in blocks of flats, with housing needs in relation to the family cycle and with certain aspects of tenant controlled heating systems. Some work in these fields is also in hand at Edinburgh University. Other B.R.S. work is concerned with offices, in particular offices for mechanised equipment, with communications and traffic in hospitals and with urban planning.

Physical requirements

11. In the field of heating and ventilating B.R.S. is considering the effect of outdoor climate (in particular wind driven rain and solar radiation) on heating needs, and Liverpool University is studying the local climate round a particular building. The Electrical Research Association is studying weather variations

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* The Nuffield Foundation's Division for Architectural studies contributed to architectural development with its investigations of hospital (and laboratory) design.

in relation to the control of off-peak heating systems. B.R.S. is studying fundamental problems of heat flow and their application by way of electrical analogues to actual buildings. The Heating and Ventilating Research Association is primarily concerned with large installations and with the engineering side of them. British Coal Utilisation R.A. is concerned with improving solid fuel boilers and with the problem of metering central heating in individual flats. Watson House Gas Research Centre is concerned with appliance design and the type of environment provided in the field of air movement. B.R.S. is making fundamental investigations and has a specific application in mind in the ventilation of internal rooms in hospitals. The Heating and Ventilating R.A. is dealing with the special problem of ventilating operating theatres.

12. In the field of lighting B.R.S. is very much concerned with the development of permanent supplementary artificial lighting, with daylighting, and with problems of glare and other types of visual discomfort.

13. The main work on sound insulation is still done at B.R.S. although the National Physical Laboratory makes some laboratory measurements of the sound insulation of walls and floors. The work at B.R.S. is directed largely to understanding the basic physics of the transmission of sound through partitions in an effort to develop a lightweight partition that will still have adequate sound insulation. The new Institute at Southampton University has, of course, not yet got going. B.R.S. is also concerned with noise problems in so far as they affect building design and town planning. The London noise survey and the propagation of aircraft noise are examples of this type of work.

ENGINEERING SERVICES IN BUILDING

14. Work at B.R.S. includes a preliminary study of the performance of air conditioning in which allowance will be made for heat gain from equipment and lighting, the problem of refuse disposal, the performance of underground ducts for heating mains, and the general problems of engineering services in so-called industrialised building. This in particular pinpoints the need for co-ordinating the design and installation work relating to a number of services and B.R.S. is working in this field particularly in connection with hospitals. The M.R.C. and the Heating and Ventilating R.A. are collaborating in work on ventilation requirements for operating theatres and the Nuffield Provincial Hospitals Trust Engineering Research Unit is investigating ventilation in hospital wards. The Heating and Ventilating R.A. is doing some operational research on the installation of heating and ventilating equipment. The use of models for planning the installation of services, initiated at B.R.S., is being studied also by the Architectural Association and at Kings College, Newcastle. The effect of wind on the performance of ventilation and air conditioning systems etc. is being studied at B.R.S. and the Universities of Bristol, Liverpool and Southampton. Single stack plumbing for tall buildings and economy in water usage are also included in the B.R.S. programme.

MATERIALS

15. Broadly speaking, manufacturers and some research associations are concerned with research on manufacture and on the development of new materials; most research associations are concerned with research on problems of use but only to a limited extent use in buildings; and B.R.S. deals with problems of use in buildings, and of the interaction between different materials, and with the sort of problem, e.g. durability, that is common to all or to a number of materials.

Cement and concrete

16. The biggest effort in materials research goes here, notably in B.R.S., the Road Research Laboratory and the Cement and Concrete Association. Some universities are also concerned. Main subjects are—basic understanding of the cementing process; development of cements for special purposes; durability of concrete and corrosion of reinforcement under normal conditions; chemical resistance of concrete; lightweight aggregate and aerated concrete; shrinkage and cracking; non-destructive testing; mix design; cement testing.

Clay products

17. The main effort is by British Ceramic Research Association and B.R.S. The former is concerned with brick making, especially drying and firing, and with the use of clay products in prefabrication. The R.A. also has work in hand on the crazing and cracking of ceramic tiles. B.R.S. effort is mainly concerned with durability (a reliable freezing test seems now to be attainable), with expansion and cracking of brickwork and with the use of ceramic units for floors and roofs.

Mortars, renderings and plasters

18. Work on tests for evaluating mortars and renderings is in hand jointly at Cement and Concrete Association, Chalk Lime and Allied Industries Research Association and B.R.S. B.R.S. is also working on frost resistance, general properties and mixes for spraying.

Metals

19. General work on metals is carried out by the appropriate Research Associations, e.g. British Iron and Steel and British Non-Ferrous Metals, and by individual development associations. B.R.S. is concerned with the use of metals in buildings, protection, corrosion, interaction with other materials, effect of condensation. Basic work on corrosion goes on at the National Chemical Laboratory.

Plastics

20. The Rubber and Plastics Research Association is investigating the relation between properties of raw materials and performance of product, and long term properties such as creep and fatigue (long term properties are also being studied by National Engineering Laboratory). B.R.S. is concerned with durability—resistance to weather and to abrasion, and fatigue. Structural uses are being studied by the primary producers. A meeting convened by the R.I.B.A. at the end of October may have the effect of increasing research effort in this field.

Mastics

21. B.R.S. is concerned with developing methods of assessing long term properties in respect of general durability, accommodation of movement and adhesion.

Paint

22. The main work is at the Research Association of British Paint, Colour and Varnish Manufacturers and is concerned with formulation, properties of paint films, and drying processes. British Iron and Steel Research Association is concerned with the efficiency of paints in preventing the corrosion of steel. B.R.S. investigates user aspects—methods of application, and the painting of plaster, concrete, asbestos cement etc.

Flooring

23. B.R.S. work on problems of flooring materials includes the assessment of wear resistance (although some university research on friction and wear is partly relevant), and the efficiency of damp-proof membranes in relation to flooring systems.

Natural stone

24. B.R.S. is co-operating with the Ministry of Public Building and Works on site trials of materials sold as stone preservatives and is concerned with frost resistance.

Watertightness of walls

25. B.R.S. is developing methods for assessing rain penetration under various climatic conditions and apparatus for measuring in-situ the water content of walls.

26. Facilities for research on the strength and stability of structures have been greatly extended during recent years and are being still further extended by the construction and equipping of new laboratories in the Universities, in D.S.I.R. establishments and in the industry itself. Active research is thus being conducted in more than thirty Universities and Colleges of Technology; in the Stations of D.S.I.R., particularly the Building Research Station, and in such laboratories as those of the Cement and Concrete Association, the British Iron and Steel Research Association, the Timber Research and Development Association, British Railways and the research and development departments of large firms of civil engineering contractors. In addition, the Civil Engineering Research Council, which was set up two years ago by the Institution of Civil Engineers in co-operation with the Federation of Civil Engineering Contractors and the Association of Consulting Engineers, is providing financial support with the assistance of D.S.I.R. for research and is helping to co-ordinate scientific efforts in the structural engineering field (amongst its other activities).

27. The range of problems being studied extends over the use of a wide variety of engineering materials and structural systems; it includes such diverse subjects as the application of electronic computers to design and the development of methods of assessing the strength of new materials.

Reinforced concrete

28. Work on shear is in progress at B.R.S., Manchester College of Science and Technology, University of Manchester, Imperial College, London, and the Cement and Concrete Association. Work on the use of hot rolled deformed bars as reinforcement is in progress at B.R.S., Cement and Concrete Association, University of Manchester, University College of South Wales and Monmouthshire, and Northampton College of Advanced Technology. Work on reinforced lightweight concrete is in progress at B.R.S., and University of Leeds.

Prestressed concrete

29. Work on continuous prestressed concrete frameworks is in progress at Imperial College, London, on prestressed concrete bridge construction at Cement and Concrete Association and on triangulated frameworks at Southampton University. Shear resistance is being studied at the Universities of Leeds, Manchester, Sheffield and Glasgow and Imperial College, London, and the Battersea College of Technology. Studies of shear and torsion are going on at the University of Leicester and the Cement and Concrete Association. The behaviour of prestressed concrete under repeated loading is being studied by British Railways, University of Leeds and B.R.S. Work on the anchorage of prestressing tendons is in hand at the University of Leeds, Queen Mary College, London, University of Southampton and the Cement and Concrete Association. Grouting of tendons is being investigated at the University of Durham. The properties of strand for prestressing are being studied at University College, Cardiff, Cement and Concrete Association and B.R.S. The fatigue strength of high tensile wire is being studied at the University of Bristol and the effect of temperature on the relaxation of stress in prestressing tendons is being studied at B.R.S. Fire resistance of prestressed concrete, in comparison with that of reinforced concrete and concrete encased in structural steelwork, is being studied by B.R.S. and the Fire Research Station.

Load-bearing walls

30. A comprehensive investigation of the strength of no-fines concrete walls is in hand at B.R.S. Research on structural brickwork is being sponsored by the British Ceramic Research Association and the Clay Products Technical Bureau, and work is in hand at B.R.S. and the University of Liverpool.

Aluminium alloy structures

31. Work is in hand in the Universities of Birmingham, Glasgow, Cambridge and Bristol, University College, London, and University College, Swansea.

Loadings of buildings

32. Work on wind loading is in progress at the National Physical Laboratory using models in wind tunnels and at the B.R.S. on a number of tall buildings. The Meteorological Office is assisting with measurements of wind velocity. Other wind tunnel work is in hand at the Universities of Liverpool and Southampton and other work on wind loading at the Royal College of Science and Technology, Glasgow, and the Heriot-Watt College, Edinburgh, and Sheffield University. Work by the Electrical Research Association and the Central Electricity Generating Board on problems affecting tall masts, overhead conductors and cooling towers is likely to have direct application to building structures generally. B.R.S. is beginning an assessment of floor and roof loads in buildings with the initial help of the Nottingham and District Technical College and the Royal College of Advanced Technology, Salford.

Timber structures

33. This is largely the province of the Timber Research and Development Association where work is concerned with the general properties of timber, tests on built up elements of construction, the development of economical forms of construction for floors, roofs and complete buildings, and studies of special structures. Other work on timber structures is in hand at Southampton University and at the Royal College of Science and Technology, Glasgow. The performance of timber joints and the strength of plywood decks is being studied at Durham University; the design of roof trusses at Battersea College of Technology and the influence of preservatives on the strength of timber at Manchester College of Science and Technology. The Forest Products Research Laboratory also has a general interest in the field.

Shell structures

34. Work in hand at Imperial College, London, is concerned with the establishment of a design theory for continuous cylindrical shell structures and the determination of the most economical shell shapes. It has also been extended to include work on doubly curved shells with particular attention to hyperbolic paraboloids. Other studies of this type of shell are in hand at the Universities of Leeds and Southampton, the Royal College of Science and Technology, Glasgow, University College, London, and the Cement and Concrete Association. The University of Southampton is concerned with the application of electronic computers to the design of shells. Timber shells are dealt with by Timber Research and Development Association.

Rigid-jointed steel frames

35. Work on ultimate load design is in progress at Manchester College of Science and Technology, the Universities of Manchester, Leeds, Sheffield and Cambridge and at B.R.S. The use of high tensile steel bolts as an alternative to rigid welded joints is being studied at the Universities of Cambridge, Bristol, Leeds and Durham and by British Railways. The use of computers in the elastic design of rigid frameworks is being studied by Manchester College of Science and Technology and Cement and Concrete Association. The strength of welded beam to column connections under repeated loading is being examined at Brixton School of Building.

Concrete frames

36. Research on the application of plastic methods of design to concrete frameworks is being undertaken at Imperial College, London, the Universities of Leeds, Nottingham and Sheffield, University College, London, and Manchester College of Science and Technology and B.R.S.

Composite action in structures

37. The inter-action between frames, walls and floors is being studied at B.R.S. and the University of Leeds. Experimental work and analytical investigations of the inter-action of floor slabs in frames are in progress at Cement and Concrete Association and the Universities of Bristol, Leeds and Cambridge and University College, London. B.R.S. is also working on composite action of

brick walls supported on beams. Composite action between steel beams and concrete slabs using various types of shear connectors is being studied at Imperial College, London and the B.R.S.

Miscellaneous

38. Work on the structural use of plastics is going on at the University of Southampton and Battersea College of Technology; design of formwork is being studied by Cement and Concrete Association; the use of glass fibre for reinforcing concrete is being investigated at Imperial College, London; the strength of joints in precast concrete construction is being studied at Salford Royal College of Advanced Technology, Battersea College of Technology and Manchester College of Science and Technology.

SOIL MECHANICS

39. This section deals with soil mechanics in its relation to building rather than to the wider field of civil engineering. For this reason, no reference is made to the work of the Road Research Laboratory or other specialist laboratories.

40. Mechanical and physical properties of soils are being studied at B.R.S. and at a number of universities. Stress-strain properties for example are being studied at Imperial College, London, and the Universities of Cambridge, Leicester, Manchester, Birmingham, Liverpool, Nottingham and Swansea and at Queen Mary College, London. The load settlement of buildings is being studied at Imperial College, London, and Northampton College of Advanced Technology. The load settlement characteristics and load transfer of piles and groups of piles is being studied at B.R.S., Battersea College of Technology, the Universities of Leeds, Leicester, Birmingham, Nottingham, Sheffield and the Queens University, Belfast. Model studies on the carrying capacity of footings are in hand in Universities of Liverpool and Nottingham and Queens University, Belfast. B.R.S. is also studying the long term uplift of buildings on shallow foundations in heavy clay when vegetation is removed. Earth pressures on walls are being studied by B.R.S. and in the Universities of Cambridge, Manchester, Liverpool and Nottingham.

BUILDING RESEARCH STATION

41. The following is a brief summary of the Station's current research programme:—

(a) *materials*	relation betwen physical and chemical properties of materials and their durability and mutual compatibility; development of new material from indigenous raw materials and industrial wastes; effect of building design on performance of materials; rain penetration, etc.
(b) *structures*	engineering design and performance of structures; interaction of frames, walls and floors; roof, floor and wind loadings; properties of reinforced prestressed, lightweight and mass concrete; soil and waste systems; sewers and underground pipelines; and other civil engineering work.
(c) *soil mechanics*	design and performance of foundations, particularly deep bored cylinders and group action in piles; stability of earthworks; tunnel linings; pressures of earth retaining structures.
(d) *engineering services*	design and performance: data for design; special problems in hospitals.

(e) *environmental*	heat transfer in buildings ; thermal response of buildings ; solar radiation ; air movement ; thermal comfort ; design and performance of natural and artificial lighting ; sound insulation ; protection against aircraft, traffic and other noise ; acoustics of auditoria.
(f) *user requirements*	user needs in houses and offices ; layout of space ; traffic in hospitals ; dimensional co-ordination ; urban planning.
(g) *building operations & economics*	development of criteria for operational assessment of industrialised building techniques ; planning techniques for office and site management ; craft skills in current building operations ; techniques for the economic assessment of housing layout and development ; methods of site-casting for large panel systems ; mechanical handling for industrialised systems ; electricity supplies on sites.

DEVELOPMENT GROUPS

42. The Development Groups which have formed one of the more significant changes in the design scene in recent years, provide an essential link between research and practice. These groups are now a feature of most Government Departments involved either directly with building, or with its financial control. They are concerned with the study of the functional requirements of particular types of buildings and with determining the real needs of the user. In the light of these studies, they develop appropriate design solutions, build them as demonstrations and appraise their performance in use, as a basis for further development. Because of the nature of their activities, these groups have tended to be comprised of a mixed team of administrators, architects, engineers, surveyors, as well as someone representing the interests of the ultimate user, for instance a school inspector or a sociologist.

43. Recently, this type of activity has spread from Central Government to the Local Government field, with the setting up of consortia, first among school authorities (C.L.A.S.P., S.C.O.L.A., * etc.), and now among local housing authorities (Y.D.G., * etc.).

44. All these Development Groups look to research for information and advice, based on the accumulated experience of research workers ; and for new studies on problems which, though they may arise in one type of building, are of more general interest. They have also relied on research for the establishment of the techniques of study which they need in their own development work ; for instance, in methods of recording site data, or studying user needs, or recording maintenance costs.

OTHER MATTERS

Fire resistance

45. An important part of building design and construction is the need to ensure safety in case of fire. The primary responsibility for fire research in all its aspects rests with the Joint Fire Research Organisation of D.S.I.R. and Fire Offices Committee. The main centre is at the Fire Research Station at Boreham Wood.

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* 'Consortium of Local Authorities Special Programme'.
'Second Consortium of Local Authorities'.
'Yorkshire Development Group'.

46. Information on the fire resistance of traditional structural elements has been built up with time. Current studies now include newer forms of construction and the properties of new materials at elevated temperatures. The effects of composite action on the fire resistance of structures are also being investigated. Changing practices in external wall construction in the form of light cladding have called for investigation on the fire resistance requirements for external walls. The determination of resistance of roofs to external fire has been concluded by the issue of a new British Standard test in B.S. 476 (Part III). Resistance to internal fire and the venting of rooms are now subjects of investigation.

47. Much attention is now being devoted to basic studies of the ignition and burning characteristics of materials, with particular reference to the spread of flame characteristics of wall and sealing linings. The broad problem of growth of fire in buildings is being studied by means of models; the fire load, ventilation and the duration and temperatures of building fires are important factors that influence requirements for fire resistance in building legislation.

Tropical building

48. Although not strictly relevant to the purpose of this review it is worth noting the existence of the Tropical Building Division at B.R.S. concerned with the application of the Station's work on problems of tropical building and also doing some applied research in this field itself relating to thermal comfort, painting problems, problems of flat roofs and light cladding.

Appendix H

SUMMARY REVIEW OF EXISTING INFORMATION SERVICES

1. Information and advice on building is available from a number of Government departments and research establishments, from research associations, from professional and trade organisations, from Building Centres, from materials and equipment manufacturers, various commercial organisations and from the technical press. This appendix summarises the activities of these bodies with the exception of the last three.

GOVERNMENT DEPARTMENTS

Ministry of Public Building and Works

2. Although these operations have been conducted on a diminishing scale in recent years, the Ministry is responsible for a Technical Information Service, regionally based, and providing local advice on most matters apart from site organisation, costing, management, wages and conditions. Its regional offices have also arranged extensive winter programmes of lectures, discussions and film shows. The Technical Information Service was responsible for the successful series of Advisory Leaflets, of which more than two million copies were sold. Originally intended for small and medium sized builders, foremen and craftsmen, they are also read by architects and engineers.

3. As well as organising the Ministry's contribution to major exhibitions, the Service has sponsored smaller exhibitions and "Building Weeks" in a number of provincial centres. The service issues a list of technical films on building and makes available on loan the Ministry's films and those of the Building Research Station.

3(*a*). An officer of the Technical Information Service also holds an appointment as Technical Officer for the London Master Builders' Association.

4. The Ministry's Library exists, in its various headquarters and regional offices, primarily to serve the professional branches of the Department. The building trade catalogue collection at the London headquarters is claimed to be the largest in the country. Smaller collections are held in most of the regional sub-libraries, each of which maintains an up-to-date subject index and is available to help technical enquirers.

Ministry of Labour

5. H.M. Factory Inspectorate deal annually with several thousand enquiries from the construction industry on matters of safety, health and welfare. The Inspectorate also engages in lecturing and demonstrations and has a modest publication activity. A section of the Industrial Health and Safety Centre in Horseferry Road is devoted to the construction industry.

Ministry of Education

Ministry of Housing and Local Government

Ministry of Health

Scottish Development Department

Department of Agriculture for Scotland

Ministry of Agriculture, Fisheries and Food

6. These Departments all publish information on building in the context of their particular responsibilities. Most is directed to the designer, some for the client and a little for the builder; the publications sell very well.

Department of Scientific and Industrial Research

7. D.S.I.R. operates a Technical Information Service, with regional offices but this has tended in practice to be mainly confined to the manufacturing industries.

GOVERNMENT RESEARCH ESTABLISHMENTS

Building Research Station

8. The Station deals annually with 6–7,000 enquiries by letter and about the same number by telephone and receives over 3,000 visitors annually, mostly for an "information" purpose. Officers of the Station give about 130 lectures each year and publish about 100 articles in the scientific, technical and lay press. Reprints of many are circulated as B.R.S. Current Papers. The Station has produced 20 technical information films for the industry, available on loan from the Ministry of Public Building and Works.

9. The Station's most influential publication is the monthly Digest; upwards of 40,000 copies of each issue are distributed, totalling well over six million copies in aggregate; additionally, many Digests are reprinted by one or more of the tchnical journals. They are directed primarily at architects, but many of the subjects covered are of interest to builders and surveyors. National Building Studies (issued as Bulletins, Special Reports or Research Papers) have sales varying from 2–15,000 copies, depending on the subject. A series of 12 Factory Building Studies recently completed has sold 6–8,000 copies per title.

10. The Station contributes to major exhibitions in the construction field, as well as to others of more specialised interest. It also holds an annual course for lecturers in technical colleges to bring them up to date on the work of the Station.

Other D.S.I.R. Stations

11. The other stations mainly concerned with the construction industry are those dealing with roads, fire and forest products. These all handle enquiries from, and issue information to the industry, even if their primary interest may lie elsewhere.

RESEARCH ASSOCIATIONS

12. It will be seen from Appendix F that there are a number of grant-aided research associations working wholly or partly in the building field. Whilst the primary duty of these associations is to their members, they all answer enquiries from non-members, and some of them issue information on building matters from time to time.

13. Although it is not a research association as normally understood—being wholly financed by the cement manufacturers, and receiving no Government grant—the Cement and Concrete Association can conveniently be dealt with here. It conducts information and advisory activities on a scale greater than that of any other single organisation and its standards are widely respected, especially in the field of publications.

14. The Association uses all the normal information media—publications, lectures, films, exhibitions, broadcasts, conferences, visitors, etc.—but also makes a special feature of its training courses. These (of which there are 40 annually) contrive more or less throughout the year, to cover all aspects of the work of the Association, and are directed to all levels and sections of the industry.

PROFESSIONAL AND TRADE ASSOCIATIONS

Royal Institute of British Architects

15. The R.I.B.A.'s Technical Information Committee is part of their Professional Services Department. Its aim is to help the architect to maintain his proficiency by encouraging the production and distribution of concise and directly applicable technical literature, by the promotion of courses and by advisory services. The Committee is to begin a technical information subscription service for members later this year. Its first publication will be a Handbook of Architectural Practice and Management which will be issued in three parts (the first part is now available).

16. Lectures and symposia have been organised in London for many years and are fully reported in the Institute's monthly " R.I.B.A. Journal" with which is circulated the monthly B.R.S. Digest, free to all members. Allied Societies arrange lectures in various regions. Weekend courses are arranged and the Institute has collaborated on a series of recorded talks with the Building Centre.

17. The Institute, in implementing joint recommendations of the R.I.B.A., R.I.C.S. and N.F.B.T.E. on the preparation of trade literature for the building industry, gives advice to advertisers on the layout and content of trade literature. The R.I.B.A. runs a Trade and Technical Literature Competition each year in conjunction with the Building Centre to promote better trade literature

18. Advice is available to members on the SfB system of filing and the Institute has published an SfB/UDC Building Filing Manual fully explaining the method of classification of information. The Technical Information Service will answer enquiries regarding its use.

19. The R.I.B.A. Library is one of the largest of its kind in the world. Reproductions of technical articles are available there, in addition to a selective technical library of the best publications on each subject. The R.I.B.A. Library Service includes the publication of Technical Reference Lists for architects showing recommended publications on building subjects and a Basic List of Books for Architectural Students. The Institute also gives advice on the organisation of library services within individual firms and keeps a list of technical films available.

20. Most technical enquiries received by the Institute are referred to the Building Research Station.

The Royal Institution of Chartered Surveyors

21. The Institution disseminates technical information mainly through its general and branch meetings, when papers on specialist and general subjects and selected topics of current interest are presented to members. Conferences of Chartered Surveyors and Quantity Surveyors provide further opportunity for discussion. There is a number of Discussion Groups and Study Groups throughout the country which were initiated by the Junior Organisation of the Institution.

22. The Cost Research Panel have produced a considerable volume of advice and information for members since their formation in 1956 and have sponsored the preparation of a number of papers relating to the cost aspects of building. The Institution set up in early 1962 a Cost Information Service which is limited to Quantity Surveyor Principals on a subscription basis. It includes cost indices, cost analyses and abstracts of current publications.

23. The Institution publishes monthly their journal "The Chartered Surveyor" which prints a number of technical papers. The Institution's Library contains over 20,000 volumes of reference books and books available on loan.

National Federation of Building Trades Employers

24. Technical information is disseminated by the National Federation in association with its 10 Regional Federations, by its affiliated Federations, such as the Federation of Registered House Builders and the National Federation of Plastering Contractors, and to some degree through the work of the Building Advisory Service.

25. The Federation has a Building Research and Technical Information Committee to co-ordinate the research and technical information activities of the Federation and a Liaison Committee with the Building Research Station to take steps to foster the development of new methods and techniques and the adoption by members of new materials and components. A Technical Officer was appointed in 1959–60 to prepare technical information and to run a Technical Enquiry Bureau which was set up in November, 1960, and receives about 400 enquiries annually.

26. The Federation circulates copies of all B.R.S. publications to members of the Building Research and Technical Information Committee and notifies Regional Secretaries of all new publications. In some Regions, members can receive on request and free of charge copies of M.P.B.W. Advisory Leaflets which are distributed by Regional Secretaries, the cost being borne by the Federation.

27. The Federation distributes its own monthly journal, "The National Builder" to members. The journal includes articles on technical subjects, provides information on new plant, materials and techniques, and frequently reprints the current B.R.S. Digest in full. "The House Builder", monthly journal of the Federation of Registered House Builders, is also issued free of charge to members. The National Federation of Plastering Contractors keeps its members informed on latest publications and British Standards related to plastering through its Technical Committee.

28. A Building Advisory Service was founded in 1954 and gives advice on management, work study and costing etc. and some incidental technical advice on materials handling and mechanisation problems. This service is non-profit making but is required to be self supporting and a fee is charged for all services. It is available to all building firms in the United Kingdom. Consultants of this Service have frequently taken part in the M.P.B.W. Lecture Programme.

29. All Regions have a Research and Technical Information Committee and some provide a regular and comprehensive service for their members. The L.M.B.A. organises lectures, film shows and exhibitions and through the part-time services of an Officer of the Ministry of Public Building and Works, is able to provide a technical information service for members.

Development Associations

30. There are a number of these bodies, each concerned with fostering the use of a specific fuel or material, e.g. electricity and coal; copper, lead, aluminium and zinc. In the course of their promotional activities they give advice and issue information, largely based, in the case of the metal development associations, on the work of the British Non-Ferrous Metals Research Association and of individual manufacturers.

Building Centres

31. These consist basically of permanent exhibitions of building materials and components. They exist in London (which was the first anywhere in the world), Glasgow, Manchester, Birmingham, Bristol, Nottingham and Southampton. Their activities are much the same in each city, with perhaps differing emphasis. Those of the Building Centre in London are described in detail.

32. The Building Centre provides facilities for manufacturers to exhibit materials, components and equipment used in all aspects of building, runs an information service on products and materials and organises exhibitions, lectures, discussions and film shows. The Centre is an independent body run by a Council of architects, surveyors, engineers and builders and is non-profit distributing.

33. The Information Service received over 182,000 enquiries in 1962. The enquiry staff give unbiased information and assistance, but no opinions of materials or products are expressed. The exhibitors are required to supply information sheets on their products which are available without charge to enquirers. The Centre has no financial interest in sales. Enquirers can be supplied with trade literature of the exhibitors and names and addresses of firms who do not maintain an exhibit at the Centre. A high proportion of the enquiries are from persons actively concerned with building.

34. The Centre issues a Monthly List of New Materials free of charge on request. The list is not restricted to products of exhibitors at the Centre. Exhibitions of new materials are held annually in various parts of the country and between six and twelve special exhibitions covering various aspects of architecture and the allied arts, crafts and industries. Some of these are organised by government departments, professional institutions and craft schools.

35. The Centre holds lunch-time film shows during the winter and provides a list of bodies from whom films may be borrowed. Building Centre Forums are a feature of the winter months when informal discussions take place between architects and manufacturers with the aim of improving products used in building. Facilities for lectures and discussions are provided, some of which are open to the general public, while others are open only to members of the organising society. Exhibitors are permitted to hold trade demonstrations. The Technical Research and Education Officer gives lectures on technical subjects to R.I.B.A. Allied Societies and similar bodies during the winter session. Recorded illustrated talks on technical subjects are available, free of charge.

36. A Brick Library of facing bricks was opened in 1961, showing the selection of bricks available arranged geographically in accordance with the regional areas of the National Federation of Clay Industries. A Technical Periodical Library covers an extensive range of technical magazines from every branch of the building industry.

37. Early in 1963, an experimental Building Information Centre was opened in Cambridge as a branch of the Building Centre, London. If it is successful, others may follow in strategic towns.

Appendix I

TECHNICAL INFORMATION ON BUILDING PRODUCTS—PAPER SUBMITTED BY NATIONAL COUNCIL OF BUILDING MATERIAL PRODUCERS

1. *Introduction*

This report describes in outline, proposals for the preparation and publication of technical information on building products to be distributed to architects, builders, quantity surveyors and other users in the building industry.

2. *The Problem*

The provision of technical information on building products has been a problem for some time. We have found references to it in articles and official reports over a long period. It should be said straight away that the problems involved are becoming continually more difficult. Building products are increasing rapidly in number, variety, specialisation and complexity and this is adding greatly to the difficulties of architects and other users in making a rational choice by comparing information about alternatives.

The seriousness of the situation is causing concern in industry since a rational choice of alternative products is dependent upon high quality information being accessible for reference in the users' office particularly where new and unfamiliar products are concerned. The fair and rational assessment of new products by users and building regulation authorities is of vital importance to healthy product design and development. In recent years in response to frequent requests from users' organisations some manufacturers have attempted to meet the request for more and better information by the provision of trade technical literature. Two serious difficulties have been encountered; in preparation and distribution. Firstly the standard of information required by users calls for considerable technical expertise in information and documentation. Secondly the problem of ensuring that expensively prepared trade literature is filed and kept has become so expensive in itself that a unified and joint attack on this aspect is necessary if costs are to be kept down.

What is now needed is for producers of information to work out a proper system of preparing and distributing information with users and sharing the cost of expert preparation and distribution as widely as possible. It is a large and serious task calling for considerable finance.

We have examined the methods and services being evolved in other countries and we are encouraged by their progress. In particular we have noted the new Catalogue du Batiment launched in France in 1960 jointly by the Institute of Architects, The National Federation of Building, the National Federation of Building Craftsmen and The Scientific and Technical Centre for Building.

3. *Solution*

Bearing these difficulties in mind we think that what is required is a new service to present technical information on building products in a simple way for direct use by industry at large. The service should be concerned solely with factual information of high quality and usefulness, and not merely a collection of leaflets for publicity and advertising.

Information of the kind we have in mind is needed by a great variety of people including architects, quantity surveyors, engineers, building craftsmen, merchants, building inspectors and even clients. Their needs overlap so we consider it best to devise a method which will present information according to the use made of it.

Quality in information has three aspects.

Content—which must be accurate and complete.

Organisation—which must be sectionalised according to the use made of the information for comparison, and selection, for drawings, contract documentation and site instructions.

Presentation—which must ensure ease of communication by visual techniques and clear simple language.

In general we accept the recommendations contained in "The Guide to the Preparation of Trade Literature for the Building Industry". It is considered that the needs of users are best met by two distinct types of technical documentation.

(i) The first requirement is for concentrated yet easily assimilated information on the whole range of products for comparison and selection. Literature of this kind will need to be selective in its scope, and must provide a maximum of essential information, clearly and concisely, presented in such a way that salient facts and figures are readily accessible for quick reference and evaluation of the product. A balance should, therefore, be struck between:

(a) a purely technical data format, aimed at the professional users (architect, engineer, quantity surveyor etc.), who may be already familiar with the general characteristics and uses of the product.

(b) a more informative type of presentation for the less knowledgeable user who may not be acquainted with either the nature or the uses of the product. In this respect, the educational aspects of technical information should be most carefully borne in mind and particularly so in the case of new products involving unfamiliar technique and products not in common use.

(ii) The second requirement is for fuller and more detailed information about some of the products, processes and special applications, for professional and other users during the stage of producing drawings and contract documents and for craftsmen for guidance on the job.

4. *Proposals*

A non-profit company should be founded to undertake the work of preparing and producing the information and distributing it widely throughout industry.

We envisage a central office for technical editing, directing and co-ordinating the work involved. Since the preparation of high quality technical documentation depends upon the close collaboration between experts who understand both the products and the particular needs of users for information, we consider that the best way to approach this huge job would be for each trade association to nominate an experienced product technologist to co-ordinate the collection of information and who would work jointly with a member or delegate of the central editorial office representing the users' point of view. Together they would be responsible for quality of information, programme and cost of the work and both would be supervised by the central office. Each group of products would be covered in this way and the SfB-System would be used to divide up the whole field of products.

Production of the publications would be directed by general technical editors who would brief typographers and illustrators and printers, and be responsible for the control of production costs.

5. *Organisation*

The organisation structure of the company should consist of:—

Supervisory Board appointed by N.C.B.M.P. for financial and policy matters, particularly the agreement of contracts with Industry Associations.

A Technical Committee under the chairmanship of a member of the Board with individual members chosen for their standing as experts in product technology, building science, architecture, building, and quantity surveying, for liaison with associations on technical matters involving policy to guide the Director of the Central Office and the Technical Editors.

A Central Office staffed by

A Director, with administrative and organising experience.

Technical Editors to direct and supervise the specialist editors and industry technologists.

Production Director for typography, illustration etc.

Specialist Editors, for liaison with industry technologists (Part time and for limited term).

Technical Editors should be architects, engineers or documentalists.

Industry Technologists to co-ordinate the supply of information from industry, and from particular manufacturers, and to prepare drafts jointly with the Specialist Editors who will be members of the Central Office.

6. *Finance*

It is hoped that eventually the scheme would be self supporting financed by Building Material Producers and assisted by contributions from Users. Assistance would be required in the initial stages, to cover the costs.

An estimate of total costs is impracticable at this stage of investigation work and the setting up of the Service.

Appendix J

NOTE ON THE RESEARCH OFFICERS' INVESTIGATIONS

Introduction

1. Out of a total of 176 organisations to whom written approaches were made (see the list in Appendix C), the Research Officers received 115 completed questionnaires and made 24 visits. Time was very short, and although the Research Officers received ready co-operation, some organisations could provide only informal evidence while others gave impromptu replies which they might have wished to modify or expand had there been an opportunity for mature reflection.

General Conclusions

2. The broad reaction of those approached was that there would be no lack of research, information and advisory activities for the proposed association to sponsor. The main reservations concerned methods of financing and administration.

3. Practitioners had few specific views on research projects but considered that the industry's research effort was not commensurate with its size.

4. All the research organisations were able to indicate, at short notice, what new projects could be brought forward or promising current work expanded. They would welcome more resources for these purposes. In the universities, building research was hampered not only by lack of finance, accommodation and qualified staff but also by a certain lack of prestige.

5. All research organisations were found to subject their research programmes to scrutiny—either for advice or approval—by some body on which the industry, or the relevant parts of it, was represented. They also took many other less formal measures to make sure that their efforts met a current or expected need.

6. Representations were received from both practitioners and research organisations that some form of co-ordination of research was necessary, though they had difficulty in defining precisely what was intended by the expression. It was generally accepted that each body which paid for research would decide how its resources should be used, and would not necessarily agree to external co-ordination. On the other hand, some bodies clearly had an uneasy feeling that in such a large and diverse field as building research there must be overlapping and many potential users of the results must be unaware of much of the work in progress.

7. In this sense, it seemed that practitioners wanted a form of central action to co-ordinate programmes and prevent overlap. Research organisations, however, saw no disadvantage in some overlapping providing it was consciously allowed. They considered that at the working level research workers would keep in touch with other relevant work and that effective co-ordination was a matter of finance.

8. On technical information and advice, the Research Officers found that most practitioners and other users (including the technical press) felt that improvements were necessary in the existing services, and that most research organisations recognised that there was more that they could do, given the resources.

9. There was again a demand for co-ordination, which in this field might include one or more of the following: central guidance on how best information should be devised and distributed; a central body to interpret research results into terms that architects and builders could use; a classification and abstracting service; more international exchanges; a regionally based advisory service for builders and architects; and an adaptation of the French Agrément system.

Research

10. The investigation produced a number of specific suggestions for research into: building operations and costs (including matters of management and human relations); requirements; and engineering services. There was a particular interest in problems of communication and contractual relationships between members of the building team. The Research Officers noted that few bodies were working in these increasingly important fields.

11. It was clear that materials, structures and foundations, by comparison, were receiving the attention of many more bodies, particularly of the research associations in the case of materials, and of the universities in the other two cases. The Research Officers concluded that much more could be done, given the resources, but that the need was relatively less pressing.

12. They had, however, one reservation on this score. Practically all the bodies visited had a high regard for British Standards and Codes of Practice, either as vehicles for transmitting the results of research or as sources of technical information. The British Standards Institution, however, stated—and this was confirmed by other evidence—that drafting was often held up for lack of essential information that only research could provide, and in this particular context the Research Officers concluded that research into materials, structures and foundations could well be increased.

Technical Information from Research

13. Linked with the question of co-ordinating research programmes was that of publishing both programmes and progress reports on individual projects. Practitioners and the technical press considered that research organisations should be more ready to mention unfinished work; research organisations were anxious to avoid premature requests for results. The Research Officers suggested that a possible solution would be earlier and more extensive publication, but with those items identified which had not progressed to the point at which enquiries could be considered.

14. The large majority of respondents deliberately sought information from the publications of research organisations, in addition to trade literature and journals. There was a widespread view, however, that information was not flowing from research either in sufficient quantity or speed; that it tended to be expressed in the language of scientists rather than of industry; and that architects were better served than builders.

15. It was stated that little at all was heard from some research organisations, possibly because their findings reached the industry through other channels such as the publication of British Standards and of building legislation. In some cases, research information was limited in principle to the membership which financed the organisation concerned.

16. The main interests of some research organisations lay in other industries, and in consequence their information work was not specifically directed to building.

Regional Advisory Service

17. A number of respondents stressed the desirability of regional information and advisory services as outlets, involving personal contact, of any central Association which may be established. They considered that the technical staff should be available to visit sites, in addition to providing architects, builders and others with more comprehensive and up-to-date information than was available in existing literature.

Product Information

18. The National Council of Building Material Producers was represented on the Working Party, while the Director of The Building Centre, London, attended one of the meetings to give evidence in person. The Research Officers also took their views into account, along with those of the many other organisations who expressed themselves under this heading.

19. There was a widespread demand for better co-ordination of technical product information. Among specific suggestions were a service on the lines of the Swedish Standard Catalogue; and an adaptation of the French Agrément system.

Appendix K

NOTE ON THE NATIONAL AGRICULTURAL ADVISORY SERVICE

(*by Mr. K. Alsop, Building Research Station*)

1. There is a fairly close parallel between the agricultural industry and the building industry. Both are traditional industries whose activities take place out of doors. Both are of the same sort of size: thus there are over 300,000 agricultural holdings in the country over one acre in size employing a total of about 800,000 people; the contracting side of the building industry consists of about 90,000 firms employing over a million people. The output of the agricultural industry is about £1,600 million per annum, and of the building industry about £3,000 million, including materials.

2. The Minister of Agriculture, Fisheries and Food has general responsibility for promoting the improvement of agriculture. As part of this function he established the National Agricultural Advisory Service in 1946, under Section 1 of the Agriculture (Miscellaneous Provisions) Act, 1944, to " give free of charge technical advice and instructions whether practical or scientific on agricultural matters ". The Service is part of the Ministry of Agriculture, Fisheries and Food.

3. The National Agricultural Advisory Service, organised in four levels (district, county, region and headquarters), is a very important channel of technical information to farmers, although some is available nowadays through other agricultural organisations. It employs about 1,400 field and specialist staff, and the direct cost of the service is about £3½ million per annum; these figures illustrate clearly the magnitude of the problem of informing and advising so large an industry.

4. Publications, demonstrations and lectures all play their part in the work of the Service, but the biggest importance attaches to personal contact between farmers and officers. Each district officer (whose training within the service takes about three years) has an area containing about 600 farms, and a typical officer will be in personal touch with about two-thirds of these. Indeed the National Agricultural Advisory Service officer's first duty is to be known to the farmers in his area. The advice given on personal visits is normally confirmed by letter immediately afterwards, and good use is made of attractively produced publications which range from free leaflets to substantial bulletins that may cost several shillings. A total of about 2½ million publications is distributed each year.

5. The advisory officers are mostly of graduate status with salaries starting in the range £769 to £1,064. The county staff are in a sense the general practitioners of the service and are backed at regional level by a range of specialists with laboratory services at their disposal. The specialists include soil nutrition chemists, entomologists, plant pathologists, analysts and bacteriologists.

6. In addition to the direct work of the advisory officers themselves, using the various information media referred to above, the Service makes considerable use of prominent farmers who are recognised by neighbouring farmers as being progressive. Not only do panels of such farmers act as consultative bodies, but the National Agricultural Advisory Service can use them to introduce innovations into their own farms which can subsequently act as potent demonstrations to farmers in the same district.

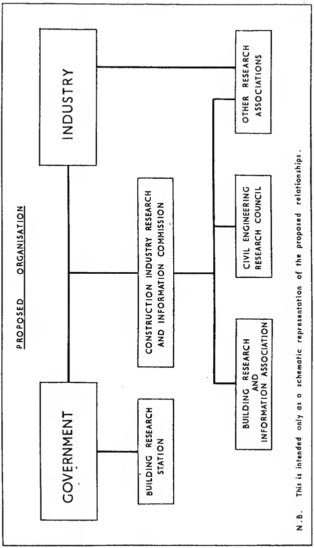
7. Although the N.A.A.S. is an advisory and not a research service, experience has shown the need for field trials and experiments to help in the application of the results of research to farming practice under varying conditions of soil and climate and in the solution of local problems. This intermediate stage falls within the sphere of the N.A.A.S. and there are twenty Experimental Husbandry Farms and Horticultural Stations. In addition to the work at the experimental centres the N.A.A.S. carried out many experiments and trials in plots at the regional centres and on commercial farms. Research is the function

of the Agricultural Research Council, and extensive steps are taken—by means, for example, of conferences and visits to research stations—to keep the advisory and specialist officers of the National Agricultural Advisory Service up to date in their knowledge of the progress and results of research. This co-operation allows the advisory officers to bring current problems to the attention of research workers.

8. The National Agricultural Advisory Service has strong working links with agricultural education through the Local Education Authorities. The Service is able to give help and advice to the L.E.A.'s directly in lecturing; by organising demonstrational and experimental activities in conjunction with farm institutes; by assisting in the introduction of special courses; and by the general encouragement of an interest in education by farmers.

Appendix L

PROPOSED ORGANISATION


INDUSTRY
GOVERNMENT
CONSTRUCTION INDUSTRY RESEARCH AND INFORMATION COMMISSION
BUILDING RESEARCH STATION
BUILDING RESEARCH AND INFORMATION ASSOCIATION
CIVIL ENGINEERING RESEARCH COUNCIL
OTHER RESEARCH ASSOCIATIONS

N.B. This is intended only as a schematic representation of the proposed relationships.

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